

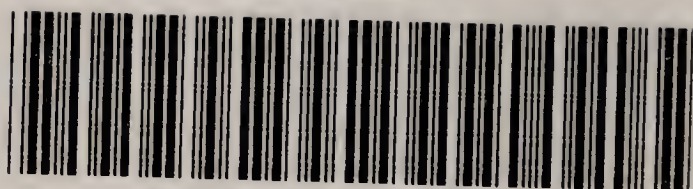
THE
EXTRA PHARMACOPŒIA

MARTINDALE
AND
WESTCOTT

VOL. II

SEVENTEENTH EDITION

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PHARMACOPŒIA

OF

Martindale and Westcott

REVISED

BY

W. Harrison Martindale, Ph.D., F.C.S.

AND

W. Wynn Westcott, M.B.Lond., D.P.H.

SEVENTEENTH EDITION.

VOL. II.

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VOLUME II.

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PREFACE.

This volume forms an addendum to the first volume of the Seventeenth Edition of the work, which was issued in advance in June, 1920.

The various sections of the book have been re-arranged to ensure a more logical sequence, but owing to the diversity of its contents it is difficult to adhere to an exact *ordo rerum*.

The sequence of the subject matter is in concordance at the outset with the information in Vol. I., *i.e.*, we commence with the Analytical Addenda to the Materia Medica in the main portion of the work, then follows a Supplement of matters to some extent yet *sub judice* or of less importance, then the Animal Organo-therapy, and finally a number of chapters which are distinctive to the second volume.

In making our additions under these various headings we have submitted many of the statements of others in recent scientific literature to laboratory trials and in following up these various opinions we have attacked numerous interesting problems.

Dealing with the **ANALYTICAL ADDENDA TO MATERIA MEDICA**, it is in the nature of things that occasional instances arise of discreditable practice on the part of a few manufacturers to "steal a march" upon others, or indeed to hoodwink the public, but on the whole it may be truly said that even during the evil days of "short commons" occasioned by the war the medical man and his patient were assured that the "drug sold provided no false description and that the article was in accordance with the purchasers' demands and that no substance was incorporated so as to render it injurious to health."

It is on the contrary very much open to question whether the same remarks always applied in regard to *Food*—either during the war or since. That is however not quite our province.

To be precise, here are a few examples of Analysts' recent findings.

There is the instance of vending Biniodide Tablets for lotions made on an incorrect basis, with the result that they contained too small a proportion of Mercuric Iodide. The use of Sodium Silicate—presumably as a 'filling'—in Soap may be regarded as extraordinary. We have remembrance also of remarkable consignments of Aspirin and Saccharin from abroad during the war before these substances were made in this country. Again, Glucose with too large a content of sulphur dioxide may be quite unsuited for pharmaceutical use. Hydrogen Peroxide with too much acidity or other preservative should be condemned. Emetine Bismuth Iodide may contain too small a proportion of alkaloid and that in an impure condition.

In the field of Essential Oils and Expressed Oils one comes across numerous intentional falsifications, for example, the recent adulteration of Olive Oil with Tea Seed Oil.

In Organo-therapy the opportunity for adulteration and misleading dealings is considerable. The deplorable " Fresh Gland " basis for Dry Thyroid Gland may be cited ; bearing upon this we may add that quite recently we found Dry Suprarenal Gland of foreign make to be inferior to a British sample, as judged by the U.S.P. Colorimetric Test.

We would, however, glance systematically over our pages :—

Acid Cresylic.—It is not to be wondered at that during the war a fractionation of commercial cresylic acid whether ' Pallid.' or ' Crude ' or ' Nig.', showed remarkable variation in content of specific fractions, more particularly as restrictions were placed upon its ingredients. Obviously a high content of the 195°—205° fraction—(the B.P. requires 90%)—is a *sine qua non*. We compare our findings with those of others.

Acid Salicylic.—An analyst provides a new distinctive test.

Acid Aceto-Salicylic.—A test depending on the formation of β -Methyl-Umbelliferone—a remarkably fluorescent body—by interaction with Resorcin has been put to the proof and the necessity for conducting a control is indicated.

The determination of free Salicylic Acid has been the subject of much research by pharmaceutical analysts. We have experimented with various methods both on Aspirin itself and on Aspirin Tablets. Limits of hydrolysed acid have been suggested. Personally we invariably feel a certain amount of pride and satisfaction when handling British-made Aspirin in pearly crystals—of a degree of purity far in excess of that of German make. Only a few weeks ago a friend determined the melting-point of a well-known brand of Aspirin obtained from Germany,—the figure was such as to lead to suspicion as to its purity.

Other workers have attacked the Aspirin problem by estimating the Acetic Acid liberated and the idea of aspirating this into water with ultimate titration has been worked out. The method was the subject of a B.P. Conference (1920) paper.

Æther.—The detection of methyl ether and the testing for Acetone have received further attention.

Alcohol.—The detection of Methyl Alcohol is a matter of importance. Methyl Alcohol poisoning is a frequently recurring evil in the U.S.A.

Arsenic.—The sensitiveness of the Marsh Test is increased by the addition of a little Arsenic-free Cadmium Sulphate and its use is now regarded as essential.

The methods of determination of the Arsenic content of Arsenobenzol have been further investigated. A recent method employing Potassium Sulphate and Sulphuric Acid as oxidising agents and the use of Starch incinerated with the mixture, with ultimate titration of the resulting Arsenious Acid with Iodine, has been recom-

mended. This process was tried alongside the author's method using Uranium Acetate with Ferrocyanide as indicator. They both give results with Arsenobenzol and 'N.A.B.' closely approximating theory.

Under **Calcium**, as also in the Supplement, under **Nitrogen Fixation**, are some important notes on the subject of acquiring and locking up atmospheric Nitrogen—a problem which had been consummated by the Germans on a commercial basis long before the war. Our supplies of Ammonia in this country were restricted by the output of our gas works and coke ovens and we were entirely dependent for Nitric Acid on the import of Sodium Nitrate. The synthetic production by the Germans of Nitric Acid during the war was a remarkable achievement.

Caoutchouc.—A versatile pharmacist has provided experimental data for preparing Plaster Mulls, previously made abroad. There is no doubt that a basis of this kind will adhere to the skin but human endeavours are sorely taxed to *remove* a piece of rubber plaster from the affected part when treatment is to be discontinued. Chloroform or Benzole is needed. A series of Plaster Mulls using a cleaner material, for example the old-fashioned Isinglass basis, would seem a desideratum.

Cinchona.—The delay and blundering on the part of our Indian Administrators some few years ago in the cultivation of Cinchona within the Empire, with its attendant humiliation (we refer to the need of going down upon our bended knees to a friendly neutral after four years of war to acquire supplies of 'Bark'), is brought out very convincingly in a recent letter of which we give a concise abstract in the Supplement. *At last* Cinchona culture in India seems to have come into its own and there are reports of marketable quantities of Quinine from the Government factories in the Nilgiris, but of peculiar interest lately is the report of the equal efficiency or even greater efficiency of the alkaloids Quinidine and Cinchonidine in benign tertian malarial infection, and for some years past it has been a moot point whether equally good results could not be obtained with the combined Cinchona alkaloids (Cinchona Febrifuge). The chemistry of Quinine is abstruse. Its complete synthesis will no doubt shortly be accomplished. One worker finds that a 10% solution of Quinine Sulphate, on heating, has its optical rotation altered from -164° to -43° , but that if the solution be heated in presence of Carbon Dioxide or Hydrogen the rotation alters from -164° to $+58^{\circ}$. In the latter case the Quinine is perhaps partly isomerised to **Quinidine**.

Quite recently Grey Cinchona Bark (*C. Nitida*) from Huanaco has been found to be extraordinarily rich in Cinchonine and correspondingly weak in Quinine—due probably to cultivation or growth at low altitudes and in hot moist atmosphere. (Unfortunately, however, Cinchonine is not well tolerated).

Digitalis.—We continue to come across opinions which support our contention, expressed several years ago, that the potency of this

drug is increased by cultivation in direct sunshine and conversely that want of sunshine and much rain have an adverse effect on its activity.

“ Abel Scholar ” has contributed a note suggesting the use of cold water in making *Digitalis Tincture*. He obtained some interesting figures and one can appreciate his mild sarcasm as to “ unfound ” glucosides.

It is of some interest that an authority on *Digitalis* finds Acetone a valuable and selective solvent of the glucosides. We hope to have the opportunity of working with it. He also finds that the Digitoxin content in the leaves is not in proportion to the physiological activity. (Most assay methods in the past have been based on a determination of Digitoxin only).

The author has continued his experiments with the colorimetric method of assay and has recently compared notes with his pharmacological friend, employing a 1920 Tincture and a Liquid Extract (10 times the strength of B.P. Tincture). The results have again been very much in accord.

Another worker has extended the author's process and has subdivided the assay into two parts. The results were communicated to the 1919 B.P. Conference.

Hydrargyri Subchloridum.—A finely divided or scaly form of Calomel has been described by a French worker. We have made this according to his formula. A formula for a prophylactic ointment made with it is also given. This type of Calomel is claimed to be exceptionally suitable for local application. We made it some years ago by a different procedure for ophthalmic use.

Calomel Ointment has been causing trouble among retailers because in one of the London Boroughs—Holborn—the Inspectors are asking for an ointment of 33 % strength without a prescription. Obviously the B.P. Ointment (20 %) does not meet the case. Some Chemists have held that it is unsafe to supply so strong a preparation except under a doctor's prescription. There would, however, appear to be no danger in its use to unbroken surfaces. We have had no adverse reports of the Unguentum Prophylaxis—Vol. I p. 453—which is 25 % strength.

Hydrargyri et Potassii Iodidum.—Mercury Potassium Iodide or Biniodide Tablets for lotions have already been mentioned. It is well to have this anomalous condition of things thoroughly ventilated. Unsatisfactory trade customs have arisen which are explained. Personally we always prepare these tablets to contain $8\frac{3}{4}$ grains of Anhydrous Mercuric Potassium Iodide. One of these in a pint of water gives the strength 1 in 1000.

Hydrargyri Oxycyanidum.—Some important data are provided regarding the manufacture of this valuable antiseptic—a substance which in the pure condition may be dangerous at certain temperatures.

Mercurochrome “ 220 ” as a vesical antiseptic is briefly dealt with.

Hydrogenii Peroxidi Liquor.—The question of preservative to be added in small quantity to this solution continues to be a matter of discussion.

Ipecacuanha.—We rather doubt the formula for Emetine Bismuth Iodide originally assigned by the introducer of this compound,—we have shown however (Vol. I.) that it is a body of variable composition.

Nutrimenta.—We have been able to include some further recent data on Accessory Food Factors—mostly subsequent to the date of our Vol. I. The Classification of Proprietary Infants' Foods by a Medical Research Committee Report, the risk of losing the antiscorbutic factor in the production of Dried Milk and the experimental feeding of animals on autoclaved food may be mentioned.

Our Chapter on Bread and Flour Standardisation stands with some alteration in view of the Vitamine theory. A leader in the B.M.J. on the subject of slack baking of bread seemed to us especially opportune and important—see our abstract p. 106.

Nux Vomica.—The presence of an alkaloid apart from Strychnine and Brucine has been hinted at.

Although the "F.I." requires a basis of combined Strychnine and Brucine in the evaluation of preparations of Nux Vomica—with which the new U.S.P. falls into line—this denomination seems to us peculiarly unfortunate, misleading and unscientific, having regard to the relative non-toxicity of the weaker base.

Oleum Olivæ.—The recently advocated test for Tea Seed Oil has been tried and found to have a good experimental basis. The relative absence of colour in the oil and acid mixture and the formation of a solid mass are distinctive for genuine olive oil.

Oleum Santali.—(with data on **Copaiba**).—This section contains some new analytical points. It was contended by the late J. C. Umney that in a new Pharmacopœia either Para Copaiba should be included or probably better, the Oil alone because the therapeutic value has been shown to be in the oil and not in the resin.

Paraffinum Liquidum.—We provide a concise account of the much discussed subject of viscosity of Liquid Paraffin (as determined by the Redwood Viscometer).

The viscosity of "oil" as a criterion of its suitability for therapeutic use is obviously of great importance. Viscosities may vary even when Specific Gravities are the same. Not only should the Specific Gravity be as high as possible (at least 0.880) but the viscosity should be at least 105 (the meaning of this figure is described in our pages).

The interesting chemical difference between Russian and American Oils is again dwelt upon.

Phenolsulphonephthalein.—This compound has interested us and we have had occasion to make it. Its use in the determination of the permeability of the kidney has been frequently the subject of communication in medical literature.

As an Indicator for the determination of the Hydrogen-ion concentration of the blood and the alveolar Carbon Dioxide tension it is of importance—it is an exceedingly delicate reagent responding to minute quantities of alkali and acid.

(The entire subject of **Hydrogen-ion Concentration** is described in the chapter on **Blood** with original references to papers. The method of making a set of Standard Colorimetric Tubes is given as also the "Collodion Sacs" for dialysis and the technique for conducting the test.

The nomenclature of the subject is fully explained on pp. **391-392**. A foreign investigator applies the symbol pH7 to indicate a neutral or normal point of blood serum which in morbid conditions, *e.g.*, acidosis, may be affected and from this a method of indicating the degree of acidity or alkalinity has eventuated).

Potassii Bromidum.—The French Codex Supplement, just issued, has a new test for chlorides in this haloid.

Quinine and other alkaloids.—We have already mentioned Cinchona Febrifuge and the work which led to the combined alkaloid therapy. Bearing upon this is a reference to the "superstition" that Quinine will prevent or cure malaria. It is said that 80% of the men who went to Salonika contracted malaria and that the cost of malarial disease incurred during the war was 50 millions a year—all due to the "Mid-Victorian superstition."

Sapones.—Our notes on pharmaceutical and other soaps are augmented by some useful advice both theoretical and practical from a paper by an authority on the subject.

Strophanthus.—The suggestion to replace the *Off.* Tincture by a preparation of Strophanthin is certainly worthy of consideration because unmixed Kombé Seeds are not now obtainable in sufficient quantity.

In the **Supplement** one may point to the information on Glass for technical purposes, Nickel (the Dimethylglyoxime test—with notes on its delicacy), Pimento Leaf Oil—the conversion of Eugenol into iso-Eugenol and this to Vanillin, Simaruba Decoction (*Mist. Simarub. et Granati*,—a recent modification of the formula), Sodium Salicylate—decoloration of solutions and its prevention, Selenium aromatic compounds, and other matters.

ANIMAL ORGANOTHERAPY.

Pituitary Gland.—Some discussion has taken place as to whether the amine termed Histamine, a constituent of the gland, is or is not the plain-muscle stimulating and depressor constituent of the infundibular portion of the gland.

Suprarenal Gland.—We give the salient points of the U.S. Colorimetric Test. The U.S. requirement is an equivalent of not less than 0.4 or more than 0.6% Epinephrine. A British sample of Dry Suprarenal Gland showed 0.8%.

Thyroid Gland.—The recently issued Second Supplement to the Dutch Pharmacopœia requires a content of 0.4% Organic Iodine and makes an important point regarding the temperature at which the desiccation is to be conducted. We think that for *sheep's* glands this requirement is too high—it is exceptional to find so much Iodine

On the other hand if Ox glands were used, which are permissible in the U.S.A. but not Official in this country, the standard referred to might be obtainable.

PHYSIOLOGICAL ASSAY METHODS.

The new U.S.P. assays ordinary galenical preparations such as the Tincture and Fluid Extract of Aconite by the killing power on guinea pigs. It would be of interest to know how a series of biological tests on diverse Tinctures and Liquid Extracts would compare with a parallel series of careful chemical assays.

In the case of *Cannabis Indica* we admit the chemist is beaten. Details of the biological method are provided.

In the matter of *Digitalis*, *Strophanthus* and *Squill*, these are assayed in the U.S.P. by determining the dose of the drug or its preparation which will arrest the heart of a standard size frog in systole in one hour's time. Owing to seasonal variation of the frog a standard of Ouabain has to be employed and corrections made if necessary—see *Digitalis*.

Desiccated Suprarenal Gland is standardised by comparing the rise in blood pressure produced in dogs with that produced by standard Epinephrine solution.

We have had frequent occasion to make abstracts from the *Journal of Pharmacology and Experimental Therapeutics*, the original articles in this periodical, dealing as they do with elaborate research by animal experiment, being obviously of extreme scientific value.

The **TABLE OF INDICATORS** is a review of those commonly used in volumetric analysis. It is the outcome of laboratory work. Some interesting data were found, particularly in the behaviour of alkaloids to indicators. It is an interesting fact that an indicator may respond well in the case of one alkaloid but not with another. *Hæmatoxylin* is quite good in the case of Quinine, Morphine and Atropine; Litmus gives a good end point with Atropine but is not satisfactory with Quinine and Morphine; Methyl Orange gives a good end point with Morphine and Atropine but Quinine is bad with Methyl Orange; Phenolsulphonaphthalein is good both with Atropine and Quinine but not with Morphine. *Hæmatoxylin* and Methyl Orange are the only good ones with Morphine.

ORGANIC ANALYSIS CHART.—Numerous bodies are added as the results of laboratory tests *e.g.*, Acriflavine, Adalin, Allantoin, Arsenobenzol, Benzyl Benzoate, Chloramine-T, Dial, Dichloramine-T, Emetine Bismuth Iodide, Iodinol, Luminal, Medinal, Papaverine, Phenoquin, Proflavine, Proponal.

Special attention is drawn to the CORROBORATIVE TESTS. There are some points of difference in the case of the ureides in behaviour with Millon's and Nessler's Reagents which may prove of importance forensically—indeed it would be impossible as result of our findings to arrange a chart of these bodies in "tree" form for purposes of elimination, to enable the analyst to track one of these bodies with comparative certainty.

IONTOPHORESIS.—Some notes are added under Acid. Monochloroacetic, Alum, Cocaine, Mercury Potassium Iodide, Sodium Chloride (Cl ions), Sodium Salicylate, and Zinc Sulphate and Iodide.

RADIOLOGY.—The introduction of Duplitized Films is no doubt a considerable advance, making for clearly defined images even with flash exposures. Needless to remark, much work was done with X-rays during the war in regard to localisation of foreign bodies. 'Telephone' attachments for affixing to surgeon's instruments are referred to. Gas in wound tissues could be readily outlined and radiographs assisted in operations for securing adequate drainage. Apart from the utility of X-rays in diagnosis and treatment a very different sphere of their usefulness was promoted, namely in revealing defects in aeroplane timber—wood being relatively transparent to X-radiation.

Tungsten Arc Light.—The amount of ultra-violet radiation obtained from any electrode appears to be proportional to the melting point of the metal. Tungsten has the highest melting point of any metal available. Electrodes made of it are therefore a most efficient source of ultra-violet light. Short exposures to the activity of ultra-violet light have been practised in various skin affections, *e.g.*, rodent ulcer, lupus, syphilis, eczema, also in the treatment of tuberculous glands and septic war wounds; but it should be noted these rays are non-penetrating and cannot be compared in efficacy, for example in Graves' disease, with the X-rays.

Ultra-violet light is germicidal to bacteria and its practical importance has been demonstrated in the direction of water sterilisation.

RADIUM.—The chief scientific or theoretical development since our last edition is concerned with the discovery of the parent of Actinium, termed **Ekatantalum**. This, in addition to adding a chemically new element to those discovered by radio-active methods, completes, according to Prof. Soddy, probably the long sequence of changes suffered by the radio-active elements. We provide details of this element and its manufacture. In this connection and also under the Atomic Weights (p. XXIX) we have a note on **Isotopes**—a name given to closely related elements, chemically inseparable but with different atomic weights.

It may be mentioned that at least six isotopes of Lead are known which differ in atomic or radio-active properties. Mercury is composed of five or six isotopes. Neon is a mixture of isotopic elements of different weights, as also is Chlorine.

The main practical use of Radium during the war was the production of luminous paints. The Admiralty specification for a Radium-Zinc Sulphide Paint has been criticised. It appears to have been a wasteful requirement. Half the Radium content would be adequate. The reason why "old" Radium is better for making these paints is explained, and the method of applying to sights and dials with a mastiche varnish is given.

Another important—exceedingly important—war development is the production of Helium on a large scale from natural sources in

Canada. We give interesting data concerning the gas. It is half as heavy as Hydrogen, is quite inert, non-explosive and therefore relatively safe. A supply of millions of cubic feet is available annually, whereas prior to 1918 the total amount isolated did not exceed 3 or 4 cubic metres. There is obviously a vast future before this newly 'tapped' product of nature.

The advances in Radium ray therapy are probably best evinced by the Annual Reports of the Radium Institute which we give in précis. Numerous independent workers have, however, also communicated their results, both with surface applicators and by imbedding needle applicators in malignant growths. Emanation tubes screened with Silver and with Platinum have been used similarly. A difficulty is encountered in that the rays, though affecting normal tissues to a less extent than morbid ones, do, nevertheless, affect them, and this is a hindrance to an unlimited increase in the *amount* of radiation employed. The treatment of tuberculous adenitis by irradiation, using a small flat circular applicator with a thin silver screen has been highly spoken of.

ANTISEPTIC POWER OF CHEMICALS AND DISINFECTANT PREPARATIONS.

We have continued our experiments (started in 1908) on this subject. The Carbolic Acid Co-efficient for a disinfectant varies for different organisms; *e.g.*, *B. anthracis* and *B. typhosus* show a variable resistance to a disinfectant. *B. Coli*, however, under standard conditions can be relied on, and in our experience gives remarkably concordant results. For all practical purposes the surgeon wants to know whether a given antiseptic preparation will kill a typical organism in a short space of time; the $2\frac{1}{2}$ minutes employed as the short period of the *Lancet* method, is a valuable criterion of efficacy and with a knowledge of 'killing power' or otherwise in this period of time it is hardly necessary to proceed with a longer period of contact (30 minutes) to the complete determination of the co-efficient.

An exact International Standard method is, however, still a desideratum. A worker in this field has reported on the use of citrated blood as diluent, and the employment of *S. faecalis* as test organism. By this method it was shown that Phenol was about 70 times as strong as Eusol and Dakin's Solution and that Malachite Green was the most potent of the antiseptics tested by him. These results are very opposed to the results obtained by using *B. Coli* as test organism and sterile water as diluent.

Whatever method is finally decided upon internationally it is important that it shall be easily workable, remove possible inaccuracies and pitfalls which would vitiate results, and that the organism used is typical in its growth of those which are likely to occur in general in bacterial wound infection.

In our own work we would point to the results in the classified alphabetical list under Acriflavine, Dakin's Solution, Eusol and the

typical aniline dyes, Crystal Violet, Malachite Green, Brilliant Green. It is of interest that Dakin's Solution is more potent than Eusol and that both of them deteriorate in bactericidal power on keeping—our investigations were conducted with the solutions on the same day as they were made.

A very important point arises with regard to the SPECIFICITY IN ANTISEPTICS. To say that antiseptics are specific for certain organisms is another way of expressing, as we have already mentioned, that the co-efficient varies for different organisms. An investigator dealing with *B. aerogenes capsulatus* found that Quinine Hydrochloride is specific against this bacillus and that for example, Phenol and Cresol show little activity against the gas bacillus while being potent against certain pyogenics. The interesting findings are all summarised on p. 348. It is obvious that this line of research is most important.

TESTS EMPLOYED IN THE EXAMINATION OF URINE, BLOOD, FÆCES, CEREBRO-SPINAL FLUID, etc.

In the chapter on **Albumin** are important points for differentiation of interstitial and parenchymatous nephritis. For the detection of protein, Salicyl-Sulphonic Acid is stated to be the best test. The extent of involvement of the renal tissue is to be determined by estimation of the urea content in the blood, by the urea concentration test of the urine and by estimating the diastatic activity of the urine. Details of the technique to be employed for each of these factors are given. It has been suggested to administer considerable doses of urea by a rather prolonged treatment, to patients suffering from marked œdema resulting from the parenchymatous type. Its use in this way has resulted in disappearance of the dropsy. The whole subject of protein diet in kidney disease requires investigation.

Abderhalden Reaction.—The correctness of this reaction as a diagnostic method is now doubted.

Benzidine as a Blood Test.—We have had experience both with the manufacture of Benzidine from Oil of Mirbane, the subsequent purification of the diamine and its use as a test for detecting small amounts of blood in urine and in faecal matter. The statements as to its use were hitherto very divergent and unnecessarily complicated. We now give succinct directions, but it is important to conduct a control test alongside the specimen. By means of the reagent we have been able to detect even 1 of blood in 100,000 parts of diluent.

Phenolphthalein and Thymolphthalein after reduction to their corresponding phthalins have been recently recommended for the detection of blood.

Arneth Index.—We give the salient points in this matter and the method of enumeration of the neutrophile leucocytes.

Re-activity of the Blood.—To use the words of a well-known physiologist "the 'strip' of variation in acidity or alkalinity of the plasma of the blood within which life is possible is a very narrow one, and it suffices to render the medium within which living cells

are situated, acid or alkaline to the feeble limit of one thousandth normal or less in order to destroy life." A consideration of the variations in the property of balanced alkalinity and acidity leads to the subject of **Hydrogen ion Concentration** which is dealt with, as already stated, in this chapter. We provide the method of conducting the determination and in addition some 'theoretical notes' on the subject explaining the fundamentals of the matter.

In the notes on **Cerebro-Spinal Fluid**, Lange's Colloidal Gold Test is mentioned. (A Permanganate Test which is said to be indicative of cerebro-spinal meningitis is given also under this heading).

Glucose in the Urine.—We took occasion to arrange the specific gravities of some diabetic urines which had been sent to our Laboratories from time to time alongside their actual Glucose content as found by Gerrard's modified Fehling Test. It will be seen, as anticipated, that some rough deductions as to the amount could be drawn from the specific gravity if sugar is proved to be present.

It has been suggested to employ the fungus *Monilia balcanica* to detect glucose. This organism will split up glucose only. Yeast is not distinctive. In the case of gas formation with the latter the specimen might contain lævulose, galactose or maltose or other sugar.

Benedict's Tests have attracted attention. It is important to note that there is a quantitative and a qualitative Benedict Test. The latter is useful for general purposes.

A further modification of the test has been used for the quantitative estimation of sugar in urine and blood depending on the reduction of the cupric salt by boiling to Cuprous Oxide, the solution of this in Hydrochloric Acid, the addition of volumetric Iodine solution in excess and the subsequent titration of this excess with Thiosulphate. We have tried the process experimentally and explain the chemical reactions which occur.

Other new Glucose Tests (under the devisers' names) are a Mercury Test and a colorimetric one by boiling the specimen with Caustic Potash Solution.

Lævulose in urine has been the subject of further research. True lævulosuria may be met with but it is apparently rare. The lævorotatory body is in reality *iso*-glycuronic acid which is differentiated by Borchardt's modified Seliwanoff's Reaction.

Total Nitrogen in urine, the non-protein Nitrogen in Blood, Blood Urea and the Ammonia content of Urine may be estimated by a Kjeldahl process using a modified Nessler Reagent.

The **Urease** (or Soy Bean) method of estimating Urea is given.

Water Analysis.—The methods of examining '**Poisoned Water**' from the military point of view—detection of Cyanides, Strychnine, Arsenic, Mercury, Copper, etc., in poisoned wells are provided, as also the methods of sterilising water with Chlorine and the filtering of water by aid of the 'Alum box' for Army use.

Occasionally *algæ* in water reservoirs give a nauseous taste to it—this is best removed by Potassium Permanganate.

The chapter on **Mineral Waters** has been shortened by the excision of data on the German and Austrian waters.

Milk Analysis.—Important figures are now given for the average composition of milk of good quality. It is shown further how these figures are affected by the addition of water in varying proportion and finally how the fat and non-fatty solids are affected by added water on the basis of the so-called 'Government Definition' of Genuine Milk (Fat 3·0%, Non-fatty Solids 8·5%).

The qualifications of *Grade "A" Milk* and *Grade "A" Certified Milk* are given.

The chapter on **Cream** supplies the latest L.G.B. Order as to the use of preservatives. We describe the method of arriving at the Polenske Number of fats to determine the purity and genuineness of **Butter**.

BACTERIOLOGICAL AND CLINICAL NOTES with reference to Special Diseases.

We have been at considerable pains to make this section as up-to-date as possible, both by reference to current scientific literature and to standard text books.

Anthelmintics.—According to a communication to the *Journal of Pharmacology and Experimental Therapeutics*, Mustard Oil, Copper Sulphate, Thymol, Chenopodium Oil, para-Dibrombenzene and para-Dichlorbenzene are highly toxic against earthworms, as also the familiar pumpkin seed. By analogy they should be of value as anthelmintics therapeutically.

Beri-Beri.—Note some useful additions to treatment.

Cancer.—The latest Cancer Research Fund Report states that Cerium Salts were found active in certain experimental conditions but had no influence on growing tumours. Tissue emulsions suspended in fully oxygenated defibrinated blood show that the rate at which oxygen is abstracted on incubation varies—the more rapidly growing tumours, with exceptions, absorb more oxygen than those growing slowly; this is a fresh line of research in connection with cancer.

Cerebro-Spinal Fever.—This infection is dealt with more particularly in Vol. I., p. 849, *et seq.* In the volume under consideration details are given of Trypagar as a culture medium with the formulæ for the requisite ingredients.

The Permanganate Test already referred to is mentioned as diagnostic. Normally the cerebro-spinal fluid is rendered pink by the addition of a dilute Potassium Permanganate solution and remains so for a short time, but in meningitis the clear fluid promptly becomes yellow.

B. Coli.—Many chronic diseases, *e.g.*, tuberculosis, rheumatism, are thought to be the effect of toxins which pervade the tissues as a

result of absorption from the intestine in chronic intestinal stasis. Detoxicated *B. Coli* Vaccine in the treatment of tuberculosis has promised far-reaching results.

Diphtheria.—The Schick Test (administration of minute doses of Diphtheria Toxin) enables differentiation between individuals who are susceptible to diphtheria and those who are not.

Dysentery.—Concise data are given for the search for *E. histolytica* in excreta, and the characters of the *entamoeba* are stated to enable distinction to be made between this and *E. Coli* and other *entamoebæ*. Notes on *Lambliæ* infections are also included.

B. Dysenteriae.—the two main groups of dysentery bacilli are shown and defined.

Gas Gangrene.—An account of *B. aerogenes capsulatus* and its cogeners. Various methods are given for combating the acidæmia—Sodium Lactate injections, Sodium Bicarbonate intravenously, a vaccine, incisions and free syringing with Hydrogen Peroxide, also Hypochlorous Acid locally. The activity of the main causative organism is immense. On infection, a whole limb may become gangrenous in ten hours and the patient be dead in sixteen hours.

The pressure produced in the tissues by the growing organism is exceedingly destructive—the mechanical effect of this is the most important factor.

Quinine Hydrochloride injections intramuscularly were proved by an authority on Specificity in Antiseptics, by self-inoculation with the organism, to be curative.

There was relatively small incidence of *B. tetani* in war wounds but *B. œdematis maligni* and *B. perfringens* were in preponderance as also the pyogenic organisms.

The wounded tissues contain anaerobes months after the original injury. Their activity depends to a great extent on their symbiosis with aerobes.

Amongst other organisms which have been isolated from cases of gas gangrene are *B. multi fermentans tenalbus* and *B. tumefaciens*.

Gonorrhœa.—Comparative tests of the utility and efficacy of numerous culture media have been made, *e.g.* Thomson's Human Plasma-Glucose Agar, Cole's Tryptic Blood Agar and Gordon and Hine's Trypsinised Pea Extract Agar. The first mentioned gives a profuse growth even in eighteen hours. It was found that the last of the three media, which is used for the meningococcus, could be slightly improved for use in cultivating the *gonococcus*.

Regarding diagnosis, failure to retain the stain by Gram's method is officially recognised. **Jensen's modified 'Gram'** technique is given in detail. This discards the use of Aniline Water, increases the concentration of the Iodine mordant and counterstains with Neutral Red.

Complement-fixation in gonorrhœa has been the subject of discussion.

Guinea Worm.—The mode of infection is dealt with and notes on

treatment are provided—Antimony Compounds and ‘N.A.B.’ have been used.

Influenza.—The organism grows best on a moist Hæmoglobin Agar containing no Glucose. In many respects it is opposite to the *gonococcus* in cultivation requirements. Blood Agar made by boiling the Agar medium with blood for a minute and separating the coagulated protein is a good medium.

The War Office Conference Vaccine formula has been revised—the proportion of *B. influenzae* being increased. This, it is thought, will render the vaccine a powerful reinforcement to measures of protection. The periodicity of influenza is noted.

Leishmaniasis.—At least three diseases in man are included under this name, *viz.*:—kala azar, oriental sore and espundia. They are, though clinically distinct, all associated with what appears to be the same organism, *Leishmania*. The classification by Sir Patrick Manson, also by A. Laveran is indicated—the latter has issued a treatise on the various forms.

Malaria.—We provide abstracts and references to numerous important papers which have appeared—*e.g.*, regarding incidence in the Egyptian Expeditionary Force, in Uganda, in Macedonia and the like.

The chapter on classification of the malarial parasites has been revised. That adopted by Sir P. Manson is concisely given.

Pellagra.—Much work has been done to determine if possible the etiology of this affection and numerous new theories have been promulgated. One investigator believes that he has established its origin in drinking water and only in such waters as arise on or travel over stagnant or argillaceous soil. It is absent, according to him, where clear and running water is consumed. Later investigations by the same worker point to a poisoning by silica in the water but the most likely explanation of the incidence of pellagra is that it is a ‘deficiency’ disease, indeed the causative agent is probably not bad food but a deficiency of food.

Syphilis.—Of the numerous methods of demonstrating *Spironema pallidum* in specimens taken for examination **Giemsa’s Stain** has some popularity.

There are two ways of staining by this stain known respectively as the ‘ordinary’ or ‘long’ method which consists in staining for twelve hours or more, and the ‘rapid’ method in which the diluted stain is employed over a burner ‘until steam rises.’ The long method has been recommended by the Medical Research Committee.

The chemistry of this stain has engaged a good deal of our work at the laboratory bench—we have been at no small pains to elucidate its component parts. Other workers have also attacked the problem and we have followed up their details. The new U.S.P. in its formula, so far as we can see, falls into several rather curious blunders. The conclusion of our work was that though Ammonia treatment of Methylene Blue may change its tint (the old ‘Giemsa’ had

a typical Trimethylamine odour), nevertheless ordinary good medicinal Blue and Eosin in the proportions stated stain spirochetes equal to the proprietary article.

As to the **Wassermann Reaction**, the Pathological Section of the Royal Society of Medicine and the Special Committee upon the Standardisation of Pathological Methods have issued details for conducting the Reaction, which are provided.

Trench Fever.—We have classified the leading papers which have appeared on Trench Fever. The name should be limited to a definite clinical entity with a peculiar temperature course, slow pulse and pain—a recurrent fever with a cycle of about five days. It should not be extended to cover any ‘P.U.O.’ As to its etiology and transmission, experiments on volunteers at the Hampstead Military Hospital showed definitely that the *excreta* of infected lice scratched into the skin produced typical trench fever in an average of eight days—the moral being to *kill lice*. The virus has been stated to be a filter passer.

Other theories were proposed in the early days but the above seems to be the truth of the matter.

Trypanosomiasis.—Sir David Bruce’s lectures which brought out a clear classification of African trypanosomes pathogenic to man and animals on a basis of morphology, pathogenic action on animals and mode of development in the insect host, have been duly summarised.

Tuberculosis.—Infectivity.—Some go so far as to prophesy that tuberculosis will in a generation be as uncommon as leprosy. The authority whose paper on the subject is given in abstract on pp. 881-882 in Vol. I., hesitates to be optimistic as to segregation stamping out tuberculosis. It seems to us that a very great deal might be done in cleaning up herds of infected cattle, though we admit the Tuberculin Test is not satisfactory and that animals may be tuberculous and yet not give the Tuberculin reaction. Dairy cattle in New Zealand are under systematic examination both on import there and in use. Owners of infected cattle are compelled to report suspected disease and compensation is granted for cattle condemned.

The regulation of the milk supply in this country appears to be unsatisfactory,—for a summary see B.M.J. Feb. 12/21, p. 236. It were better to put the country to expense on the New Zealand lines than to pay out-of-work claims to many who are intentionally out of work—or in thousands of other ways to drain the tax-payer in wasteful unremunerative projects.

Typhoid.—Standard cultures and agglutinating sera for diagnosis are now available, including *B. typhosus*, *B. paratyphosus* ‘A’ and ‘B’ and other organisms.

Atropine injection hypodermically as a means of diagnosis seems remarkably simple—the details of procedure are given.

To differentiate *B. typhosus* and *B. paratyphosus* ‘A’ and ‘B’ **Phenolsulphonephthalein** has been suggested as an addition to

culture media by a method based on the Hydrogen-ion concentration reached in growth of the organisms.

The Brilliant Green and Telluric Acid Isolation method is given, as also the formula for Endo's Medium and Hiss's Medium.

Typhus Fever.—A great deal has been written on the subject of typhus, a disease which always flourishes in times of war owing to over-crowding, exhaustion and ill-nourishment. We give notes from numerous theoretical and practical communications.

Weil's Disease.—According to an authority the term should be abolished. For cases of the kind in which no specific spirochete or other infection is found it would be better to use the term *hæmorrhagic infective jaundice*. *Sp. icterohæmorrhagiæ* made its first appearance in 1916 in Flanders as the cause. It is responsible for epidemics in Japan.

Yaws.—Novarsenobenzol has a rapid and remarkable curative action but if we recollect rightly in the "Cruise of the Snark" some on board swore by Sublimate, while the author himself advised *California* as the only cure!

Yellow Fever.—Its transmission is made clear by the American work on this fever. The germ is a filter passer. Several recent papers are referred to.

Proprietary Medicines. We summarise the information available at the time of going to press on the Proprietary Medicines Bill now before Parliament. That this measure will in its final form do good there is little doubt, but the liberty and privileges of the subject need reasonable conservation.

THE INDEX which applies both to Vol. I. in ordinary type and to Vol. II. items in black type (thus **200**), will, it is hoped be found useful.

London, March, 1921.

W. HARRISON MARTINDALE
W. WYNN WESTCOTT.

INTRODUCTION.

The subjects dealt with in this volume are arranged, as explained in the preface, in the same sequence as in the body of Vol. I.

The question of POISONS (in the light of the Poisons and Pharmacy Acts and recent Orders in Council), has not received full consideration in this volume, as circumstances hardly necessitate it. In Vol. I., however, we indicate, as in previous Editions of the Extra Pharmacopœia, into which part of the Poisons Schedule any substance falls, by means of the signs **P1** and **P**

Note however the Recent (1921) Revisions on page xxxi.

The CROSS REFERENCES in the following pages, *unless otherwise stated*, refer to Vol. II., and in each instance are in heavy type, thus, **100**.

ABBREVIATIONS.

When the reference is to a periodical, the number put first is the number of the volume; then follow the last two figures of the year, and the last number refers to the page, thus, B.M.J. i./20,500.

- A.R.—List of Reagents for Analytical Purposes prepared by a Special Committee appointed by the Councils of the Institute of Chemistry of Great Britain and Ireland and the Society of Public Analysts and other Analytical Chemists.—London, 1915.
- Allen.—Allen's Commercial Organic Analysis—Edited by H. Leffmann, M.A., M.D., W. A. Davis, B.Sc., A.C.G.I., and S. S. Sadtler, S.B., 1909–1917, 9 vols.
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- Am.Jl.Ph.—American Journal of Pharmacy.
- Batty Shaw—Organotherapy, or Treatment by means of preparations of Various Organs, H. Batty Shaw, M.D., F.R.C.P., 1905.
- Beddoes.—Syphilis, Its Diagnosis, Prognosis, Prevention and Treatment, T. P. Beddoes, 1909.
- B.Pt.—Boiling Point.
- B. & C. P.—British and Colonial Pharmacist, London, previously B. & C. D.—British and Colonial Druggist.
- B.M.J.—British Medical Journal, London.
- B.M.J.E.—British Medical Journal Epitome.
- Berl. Klin. Woch.—Berliner Klinische Wochenschrift, Berlin.
- Bosanquet.—Serums, Vaccines and Toxins in treatment and diagnosis, W. Cecil Bosanquet, M.D., 3rd Edition, 1916.
- B.P.C.—British Pharmaceutical Codex, 1911, and Supplement, 1915; B.P.C. 1894 or 1901—Formulary of the British Pharm. Conference. B.P.C. Supp. 1908,—Supplement to 1907.
- Brickdale.—J. M. Fortescue-Brickdale, M.A., M.D., Guide to Newer Remedies, 1910.
- Brompton H.—Pharm. Brompton Hospital, 1899.
- Brooke.—Gilbert E. Brooke, Tropical Medicine, Hygiene and Parasitology 1908.
- Brunton.—Text-Book of Pharmacology, Therapeutics, and Materia Medica. by Sir T. Lauder Brunton, M.D., 3rd Edition, 1891; also Therapeutics of the Circulation, 2nd Edition, 1914.
- Can. Form.—The Canadian Formulary of Unofficial Preparations.
- Caspari.—Pharmacy for Students and Pharmacists, C. Caspari, jun., 1906 and (4th Edition), 1910.
- C.D.—Chemist and Druggist, London.
- C.H.W.—Formulæ of Chelsea Hospital for Women, 1900.
- C.L.T.E.—Central London Throat and Ear Hosp. Pharm., 1901.
- Chem. News.—Chemical News, London.
- Clin. Jl.—Clinical Journal.
- Colyer's Dental Surgery and Pathology:—3rd Edition, 1910, and 4th Edition, 1919 (previously Smale & Colyer's Diseases and Injuries of Teeth).
- Comptes Rend.—Comptes Rendus Hebdomadaires des Séances de L'Académie des Sciences.
- C.R.—Proposed changes in the British Pharmacopœia, in accordance with the International Agreement for the Unification of Pharmacopœial Formulas for Potent Drugs signed at Brussels, Nov. 29, 1906, from a report to the Pharmacopœia Committee of the General Medical Council. Adopted by the Committee of Reference in Pharmacy, March 4, 1907. Further reports in 1908, 1910, 1911: *c.f.* Edition XV., p. xxiv.
- C.X.—Charing Cross Hospital Pharm. 1917.
- Cushny.—Text Book of Pharmacology and Therapeutics, Arthur R. Cushny M.A., M.D., F.R.S., 7th Edition, 1918.
- Dawson Turner.—Radium, its Physics and Therapeutics, by Dawson Turner, B.A., M.D., 2nd Edition, 1913.
- D.M.W.—Deutsche Medizinische Wochenschrift. Leipzig.

- Digitalis Assay.—W. H. Martindale. A communication to the Pharmaceutical Society of Great Britain, 1913. (H. K. Lewis & Co., Ltd.)
- Disp.—Art of Dispensing, Peter MacEwan, F.C.S., Ph. Ch., 9th Edition, 1912.
- E.L.—Pharm. of East London Hospital for Children, 1903.
- E.—Pharm. of Evelina Hospital, Southwark, 1906.
- Ed.M.J.—Edinburgh Medical Journal.
- Edition XVI.—Sixteenth Edition of this work (1915).
- Emery.—Clinical Bacteriology and Hamatology, W. D'Este Emery, M.D., B.Sc., 5th Edition, 1917.
- Evans.—Evans' Analytical Notes for 1914-1919.—Evans Sons, Lescher and Webb, Ltd., London and Liverpool.
- E.P.I.—Economic Products of India, 1889-96.
- F.E.—Farmacopea Española Septima Edición, 1905, Madrid.
- F.I.—Formula Internationalis, International Agreement for Unification of Formulas signed 1906—*c.f.* C.R. *antea*.
- F.N.—Formulaire des Médicaments Nouveaux. Bocquillon-Limousin, 23rd Ed., 1911, and previous Editions. Paris
- F. Norsk.—Den Norske Farmakopø, 1913. Norwegian Pharmacopœia.
- FR. CX.—Codex Medicamentarius Gallicus, Pharmacopée Française. Paris, 1908, and Supplement.
- G.—The Essentials of Materia Medica and Therapeutics—Sir A. E. Garrod, M.D., and Sir N. J. C. Tirard, M.D., 13th Edition, 1890.
- G.H.—Pharmacopœia of Guy's Hospital, 1916.
- Garrod.—Sir A. E. Garrod, D.M., M.A., Inborn Errors of Metabolism, 1909, and other communications.
- Gehe.—Gehe's Codex der Bezeichnungen von Arzneimitteln, 1910 and 1914
- Ghosh.—Treatise on Materia Medica and Therapeutics, by the late R. Ghosh, L.M.S., Cal. Univ. Edited by B. H. Deare, Lieut.-Col. I.M.S. 7th Edition, 1918 (and Abstracts from earlier Editions).
- Glyn-Jones.—The Law of Poisons and Pharmacy. W. S. Glyn-Jones.
- Gould.—The Practitioner's Medical Dictionary, by G. M. Gould, A.M., M.D., 3rd Edition, 1916.
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- G.N.C.—Pharm. Gt. Northern Central Hospital, 1908.
- Gt. Orm. H.—Gt. Ormond St. Hosp. Children Pharm., 1915
- Green.—Green's Encyclopedia of Medicine and Surgery.
- Hager.—Handbuch der Pharmaceutischen Praxis, 1907.
- H.—Text Book of Practical Therapeutics, Hobart Amory Hare. 17th Edition, 1919 (and abstracts from earlier Editions).
- Hewlett.—Serum and Vaccine Therapy, T. R. Hewlett, 2nd Edition, 1910, also Bacteriology, 6th Edition, 1918.
- H.W.—W. Hale White, M.D., Materia Medica, Pharmacy, Pharmacology, and Therapeutics, 13th Ed., 1913, 14th Ed., 1915, and 16th Ed., 1918.
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- I.C. Add.—Indian and Colonial Addendum (1900) to the B.P., 1898.
- I.D.C.—Indigenous Drugs Committee, 2nd Report, Simla, 1909. Third Report, Calcutta, 1916.
- I.M.G.—Indian Medical Gazette.
- I.V.—Iodine Value.
- Int. Cong.—VIIth International Congress of Applied Chemistry, London May, 1909 (papers read at); also VIIIth Congress, Washington, 1912.
- J.C.S.A.—Journal of the Chemical Society. Abstracts. London.
- J.C.S.T.—Journal of the Chemical Society. Transactions. London.
- J.R.S.—Journal of the Roentgen Society. London.
- Jl.A.M.A.—Journal American Medical Association.
- K.C.H.—King's College Hospital Pharmacopœia, 1916.
- Knox.—Radiography, X-Ray Therapeutics and Radium Therapy by Robert Knox. 2nd Edition in 2 vols., 1918.
- L—The Lancet, London.
- Leduc.—Electric Ions and their use in Medicine, Prof. S. Leduc, translation by R. W. Mackenna, M.A., M.B., etc., 1908.

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- L.—London Lock Hospitals Pharmacopœia, 1919.
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- M.—Annual Report of E. Merck.
- M.A.—Medical Annual.
- M. An.—Merck's 1907 Index (New York)
- M. Index.—Merck's Index, 1911.
- m.a.—Milliampere
- Mann.—J. Dixon Mann, M.D., F.R.C.P., Physiology and Pathology of the Urine, 2nd Edition, 1908.
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- M.P.C.—The Medical Press and Circular, London
- M.Pt.—Melting Point.
- Murrell.—“What to do in cases of Poisoning,” by the late William Murrell, M.D. 11th Edition, 1912.
- Na.—“Nature,” London.
- N.E.H.—Pharm. of the North-Eastern Hosp. (now called Queen's Hosp. for Children), 1911. New Edition promised.
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- N.H.W.—Pharmacopœia of the New Hospital for Women, London, 1904.
- N.N.R.—New and Non-official Remedies, Amer. Med. Assn.
- N.S.D.—National Standard Dispensatory.
- O.R.—Optical Rotation of Essential Oils (100 m.m. tube) @ 20.0 C.
- Off.—Official—in the British Pharmacopœia.
- Oph.—The Ophthalmoscope. London.
- P.N.F.—Proposed National Formulary (U.S.).
- P.R.S.M.—Proceedings of the Royal Society of Medicine, London.
- [P1]**.—Part I. Poisons Schedule, 1908. See Vol. I., p. 945.
- (P)**.—Part II. Poisons Schedule, 1908. See Vol. I., p. 945.
- P. Austr.—Pharmacopœia Austriaca, vii.; 1906.
- P. Aus. Add.—“Additamenta.”
- P. Belg.—Pharmacopœia Belgica, Editio Tertia, 1906.
- Ph. Bor.—Pharmacopœia Borussica. (Russian.) Ed. VI. 1910.
- P. Dan.—Pharmacopœia Danica, 1907.
- P.G.V.—Pharmacopœia Germanica, 5th Edition, 1910.
- P. Helv.—Pharmacopœia Helvetica, Ed. IV., 1907.
- P. Hung.—Pharmacopœia Hungarica, Editio Tertia, 1909.
- P. Ital.—Italian Pharmacopœia, 3rd Edition, 1909.
- P.I.—Pharmacopœia of India, 1868.
- Pg.I.—Pharmacographia Indica, 1890–1893.
- P.J.—Pharmaceutical Journal and Pharmacist, London.
- P.J.F.—Pharmaceutical Journal Formulary
- P. Jap.—Pharmacopœia Japonica, III., 1907, and 1912 and 1913 revisions.
- P.L.—Pharmacopœia Londinensis, 1851.
- P.M.C.E.—Select Parliamentary Committee on Proprietary Medicines Enquiry, 1912–1913.
- P.R.—Perfumery and Essential Oil Record. Edited by the late J. C. Umney, F.C.S., and currently by A. C. Merrain, London.
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- Pres.—The Prescriber, monthly, Thos. Stephenson, Edinburgh.
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- Prov. Hosp.—Provincial Hospital Pharmacopœias, issued by the Chemist and Druggist, London.
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- R.O.H.—Pharmacopœia, Royal London Ophthalmic Hospital, 1911.
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- S.H.—Pharm. Samaritan Free Hospital, 1912.
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- Sp. Gr.—Specific Gravity at 15.5° C., unless otherwise stated.
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* In connection with a text heading signifies that the name which it precedes is a British Registered Trade Mark, *e g.*, *Exalgine. The * is only applied to the principal heading and is not repeated throughout the book

INTERNATIONAL, 1917, ATOMIC WEIGHTS.

The Molecular Weights of Compounds following symbols in our work are given throughout in terms of the International, 1917, Atomic Wts.

	I. Wts. O = 16.
Aluminium	Al 27.1
Antimony	Sb 120.2
Argon	A 39.88
Arsenic	As 74.96
Barium	Ba 137.37
Bismuth	Bi 208.0
Boron	B 11
Bromine	Br 79.92
Cadmium	Cd 112.4
Cæsium	Cs 132.81
Calcium	Ca 40.07
Carbon	C 12.005
Cerium	Ce 140.25
Chlorine	Cl 35.46
Chromium	Cr 52.0
Cobalt	Co 58.97
Columbium	Cb 93.1
Copper	Cu 63.57
Dysprosium	Dy 162.5
Erbium	E 167.7
Europium	Eu 152.0
Fluorine	F 19
Gadolinium	Gd 157.3
Gallium	Ga 69.9
Germanium	Ge 72.5
Glucium	Gl 9.1
Gold	Au 197.2
Helium	He 4.0
Holmium	Ho 163.5
Hydrogen	H 1.008
Indium	In 114.8
Iodine	I 126.92
Iridium	Ir 193.1
Iron	Fe 55.84
Krypton	Kr 82.92
Lanthanum	La 139.0
Lead	Pb 207.2
Lithium	Li 6.94
Lutecium	Lu 175.0
Magnesium	Mg 24.32
Manganese	Mn 54.93
Mercury	Hg 200.6

	I. Wts. O = 16
Molybdenum	Mo 96.0
Neodymium	Nd 144.3
Neon	N 20.2
Nickel	Ni 58.68
Niton (Ra Emanation) ..	Nt 222.4
Nitrogen	N 14.01
Osmium	Os 190.9
Oxygen	O 16.00
Palladium	Pd 106.7
Phosphorus	P 31.04
Platinum	Pt 195.2
Potassium	K 39.1
Praseodymium	Pr 140.9
Radium	Ra 226.0
Rhodium	Rh 102.9
Rubidium	Rb 85.45
Ruthenium	Rn 101.7
Samarium	Sa 150.4
Scandium	Sc 44.1
Selenium	Se 79.2
Silicon	Si 28.3
Silver	Ag 107.88
Sodium	Na 23.0
Strontium	Sr 87.63
Sulphur	S 32.00
Tantalum	Ta 181.5
Tellurium	Te 127.5
Terbium	Tb 159.2
Thallium	Tl 204.0
Thorium	Th 232.4
Thulium	Tm 168.5
Tin*	Sn 118.7
Titanium	Ti 48.1
Tungsten	W 184.0
Uranium	U 238.2
Vanadium	V 51.0
Xenon	X 130.2
Ytterbium	Yb 173.5
Yttrium	Yt 88.7
Zinc	Zn 65.37
Zirconium	Zr 90.6

* H. V. A. Briscoe on a redetermination of the atomic weight of this element found as a mean 118.699.—C.D. Dec. 12/14. Ind. Fo. 794.

The **1920 Figures** which are **not** used in this edition of our work contain the following alterations:—

Argon 39.9
Boron 10.9
Gallium 70.1

Nitrogen 14.001
Thorium 232.15
Yttrium 89.33

Suggested International Atomic Weights for Pharmaceutical Purposes.

(From a paper by W.H.M., read at an Evening Meeting of the Pharmaceutical Society of Great Britain, in London. P. J. i./II 170, 178).

The atomic weights of elements employed in the pharmacopœias of different nations show variation in magnitude, particularly with regard to the first, second and third place of decimals. The important elements arsenic, bismuth, bromine, chlorine, iodine, lithium, silver, sodium, all show variations, and these are not accounted for by the fact that the oxygen standard is adopted by some and the hydrogen standard by others. The international Committee on Atomic Weights every year introduces corrections, necessary scientifically from time to time; for example, the Committee of 1909 introduced corrections in chlorine, sulphur, iodine, magnesium, and sodium. In 1910 arsenic and chromium were altered. In 1911 lithium, phosphorus, platinum, and strontium (*inter alia*) were altered. In 1912 calcium, iron, mercury and thorium were amongst those altered*. The author suggests the following 'Rounded off' weights which are those in the French Pharmacopœia, with the exception of a slight alteration of Platinum and the addition of Cerium, Thorium and Tin, as sufficiently accurate for general pharmaceutical work. If "rounded-off" *International Standards for Pharmaceutical Purposes* could be arranged, they would tend to general uniformity. These pharmaceutical standards should, it is suggested, be officially adopted in the pharmacopœias in different countries on their next revisions, and should remain in force for some years, or until some important discovery necessitated a complete radical change in one or more of the weights. It is obviously unsatisfactory for a pharmacopœia of any nation to adopt International Weights issued by the Committee thereon as is the custom, because these are continually fluctuating—particularly in view of the fact that a pharmacopœia is usually current as a standard work for a period of ten years or thereabouts. The pharmacist, however, in carrying out his pharmaceutical operations is able to control his products without the necessity of employing ultra-scientific figures. The author has not lost sight of the fact that analytical data would be influenced by a "rounded-off" revision. The influence, on the whole, would be for the general good. Again, an International Unification for pharmacy, as suggested, would do away with the extraordinary anomaly of seven current European pharmacopœias giving one of the most important elements four different weights, and only two of the four agreeing with the current "International Atomic Weights."

*The 1917 figures contained alterations in Carbon, Helium, Lead, Radium Sulphur, Thallium and others.

Suggested International Atomic Weights for Pharmaceutical Purposes.

Aluminium	27	Lithium	7
Antimony	120	Magnesium	24
Arsenic.....	75	Manganese	55
Barium	137	Mercury	200
Bismuth.....	208	Nitrogen	14
Boron	11	Oxygen	16
Bromine.....	80	Phosphorus	31
Calcium	40	Platinum	195
Carbon	12	Potassium.....	39
Cerium	140	Silicon	28
Chlorine	35.5	Silver.....	108
Chromium	52	Sodium	23
Copper	63.5	Strontium	88
Gold	197	Sulphur	32
Hydrogen	1	Tin.....	119
Iodine	127	Zinc	65
Iron	56	Thorium	232
Lead	207		

ISOTOPES AND ATOMIC WEIGHTS

Contrary to the Atomic Theory of Dalton (1801) that atoms of the same element are similar to one another and equal in weight, the view now (mostly based on the work of Sir E. Rutherford and his colleagues on Radio-activity) is that there must exist elements which have chemical properties, identical for all practical purposes, but the atoms of which have different weights.

Chlorine is a complex element and consists of isotopes of atomic weights 35 and 37 with possibly another at 39. Mercury is composed of five or six isotopes, and so on.

All the atomic weights of all elements so far measured are exactly whole numbers on the scale 0=16. Hydrogen is the exception. By the spectrum method of determination H. is still 1.008.—F. W. Aston, Na. July 15/1920,617.

Regarding Chlorine,—Separation of the element into Normal Chlorine and Meta Chlorine and the Positive Electron, see also F. W. Aston, Na. Dec. 18/19, Apl. 22/20, 231; D. L. Chapman, *ibid.* June 17/20,487, July 15/20,611; F. Soddy, *ibid.* June 24/20, 516, and July 22/20,642, and A. F. Core, *ibid.* July 29/20,677.

PERIODIC TABLE OF ELEMENTS FOUNDED ON THAT OF MENDELEEFF (EMPLOYING 1915 ATOMIC WEIGHTS.)

Zero Group.	Group I.	Group II.	Group III.	Group IV.	Group V.	Group VI.	Group VII	Group VIII
x								
y	H = 1.008							
He = 3.99	Li = 6.94	Gh(Be) = 9.1	B = 11	C = 12	N = 14.01	O = 16	F = 19	
Ne = 20.2	Na = 23	Mg = 24.32	Al = 27.1	Si = 28.3	P = 31.04	S = 32.07	Cl = 35.46	
A = 39.88	K = 39.1	Ca = 40.07	Sc = 44.1	Ti = 48.1	V = 51	Cr = 52	Mn = 54.93	Fe = 55.84 Co = 58.97 Ni = 58.68
	Cu = 63.57	Zn = 65.37	Ga = 69.9	Ge = 72.5	As = 74.96	Se = 79.2	Br = 79.92	
Kr = 82.92	Rb = 85.45	Sr = 87.63	Yt = 89	Zr = 90.6	Cb = 93.5	Mo = 96		Ru = 101.7 Rh = 102.9 Pd = 106.7
	Ag = 107.88	Cd = 112.4	In = 114.8	Sn = 119	Sb = 120.2	Te = 127.5	I = 126.92	
Xe = 130.2	Cs = 132.81	Ba = 137.37	La = 139	Ce = 140.25				
			Yb = 172		Ta = 181.5	W = 184		Os = 190.9 Ir = 193.1 Pt = 195.2
	Au = 197.2	Hg = 200.6	Tl = 204	Pb = 207.1	Bi = 208			
		Ra = 226.4		Th = 232.4		U = 238.5		

In an Appendix to "The Principles of Chemistry, 1905," Mendeléeff included the elements of the Argon group and Radium, and found places in addition for two hypothetical elements which he placed before Helium and designated x and y . y is supposed to be an analogue of Helium and may be identified hereafter with "Coronium" which has been recognised in the Sun's coronal atmosphere. This gas according to Mendeléeff would have density about 0.2 and therefore, molecular weight 0.4 or about $\frac{1}{10}$ that of Helium.

x is the 'Ether' for which Mendeléeff supposes a molecular structure. It is assumed to be inert like the Argon group and to possess a low density and Atomic Weight estimated at 0.000,000,000,053.—Mendeléeff Memorial Lecture.—Tilden, "Nature," 3/2/10, p. 416.

An element with the atomic weight 3 has been found by J. J. Thomson—? some allotropic variety of Hydrogen analogous with Ozone and Oxygen. An element with this weight had been predicted by Mendeléeff, who endowed it with super-fluorine properties —P. I. i. 12. 101.

POISONS SCHEDULE.

REVISIONS, JANUARY 3rd, 1921.

Note in particular the transference of preparations containing **0·1% Cocaine** (and **Ecgonine**) to Part I., the alteration in **strength of Opium preparations**, and the addition of **Diamorphine and its preparations**, so far as Part I. is concerned, and the **addition of Zinc Chloride** and its preparations to Part II.

The Order in Council Dec. i./20, embodies the following :—

PART I. marked [P1] in our Text (Vol. I.).

Coca, any preparation or admixture of, containing 0·1 or more per cent. of coca alkaloids.

Diamorphine (also known as HEROIN), and all preparations or admixtures containing 0·1 per cent. of diamorphine.

Ecgonine, and all preparations and admixtures containing 0·1 per cent. of ecgonine. (*Added January 3/1921*).

Opium, and all preparations or admixtures containing 0·2 or more per cent. of MORPHINE.

PART II. marked (P) in our Text (Vol. I.)

Zinc Chloride and liquid preparations of zinc chloride, *except* preparations intended to be used for soldering or other purely industrial purpose, provided that they are contained in closed vessels labelled with the word "Poisonous" and bearing the name and address of the seller and a notice of the special purpose for which the preparations are intended.

APPROXIMATE EQUIVALENT WEIGHTS.

IMPERIAL TO METRIC.

grain	Gm.	grain	Gm.	grains	Gm
$\frac{1}{10000}$	= 0·000065	$\frac{1}{4}$	= 0·016	15	= 1·0
$\frac{1}{2000}$	= 0·0003	$\frac{1}{3}$	= 0·02	20	= 1·2
$\frac{1}{1000}$	= 0·0006	$\frac{1}{2}$	= 0·03	30	= 2·0
$\frac{1}{64}$	= 0·001	$\frac{3}{4}$	= 0·05	45	= 3·0
$\frac{1}{50}$	= 0·0013	1	= 0·06	60	= 4·0
$\frac{1}{40}$	= 0·0015	grains		90	= 6·0
$\frac{1}{32}$	= 0·002	$1\frac{1}{2}$	= 0·1	120	= 8·0
$\frac{1}{25}$	= 0·0025	2	= 0·12	150	= 10·0
$\frac{1}{20}$	= 0·003	3	= 0·2	180	= 12·0
$\frac{1}{16}$	= 0·004	4	= 0·25	$\frac{1}{2}$ ounce	
$\frac{1}{12}$	= 0·005	5	= 0·3	(av.)=	15·0
$\frac{1}{10}$	= 0·006	6	= 0·4	1,,	= 30·0
$\frac{1}{8}$	= 0·008	8	= 0·5	(or nearer	28·35
$\frac{1}{6}$	= 0·01	10	= 0·6	1 pound	
$\frac{1}{5}$	= 0·012	12	= 0·8		= 453·59

METRIC TO IMPERIAL.

1 kilogramme	..	..	..	= 2lb. 3 $\frac{1}{4}$ oz.
500 Gm.	..	..	..	= 1,, 1 $\frac{5}{8}$,,
100 „	..	..	..	= 3 $\frac{1}{2}$ oz.
25 „	..	..	..	= $\frac{7}{8}$ „
10 „	..	..	..	= $\frac{1}{3}$ „
1 „	..	..	..	= 15·43 grains.
$\frac{1}{2}$ „ or 500 milligrammes	..	..	..	= 7·7 „

MEASURES. IMPERIAL TO METRIC.

minim	Cc.	minims	Cc.	fluid oz.	Cc.
$\frac{1}{2}$	= 0·03	15	= 1·0	1	= 30·0
1	= 0·06	20	= 1·2	fluid ozs.	
minims		25	= 1·5	2	= 60·0
2	= 0·12	30	= 2·0	4	= 115·0
3	= 0·2	40	= 2·5	5	= 140·0
4	= 0·25	45	= 3·0	6	= 170·0
5	= 0·30	60	= 4·0	8	= 230·0
6	= 0·4	90	= 6·0	10	= 280·0
8	= 0·5	120	= 8·0	20	= 568·0
10	= 0·6	240	= 15·0	gallon	litres.
12	= 0·8			1	= 4·536

MEASURES. METRIC TO IMPERIAL.

1 Cc.	..	..	..	= 15 (nearer 17) minims.
1 litre	..	..	..	= 1 pint 15 fl. oz. approx.

MEASURES OF LENGTH.

1 micromillimetre	= $\frac{1}{1000000}$ millimetre, usually represented by $\mu\mu$.
1 micron	= $\frac{1}{1000}$ millimetre, or 1 micrometre, „ μ .
1 millimetre	= 0·039370 inch.
1 centimetre	= 0·3937 inch.
1 decimetre	= 3·937 inches
1 metre	= 39·370113 inches or 1 yard 3·37 inches nearly.

ANALYTICAL ADDENDA TO MATERIA MEDICA CONTAINED IN VOL. I.

ACETANILIDUM.

Acetanilide and Methylene Blue Tubes. *Syn.* TUBES TÉMOINS.
Sealed glass tubes filled with Acetanilide Powder and containing in addition in the centre a small pinch of Blue Dye. These are used to place in sterilisers to determine whether sterilisation has been adequate and has penetrated into the centre of the dressings. Acetanilide melts at 113° C., hence if this temperature has been reached the contents of the tube on removal should be evenly blue throughout.

Tests for Recognition.—See Organic Analysis Chart and Corroborative Tests.

Deaths from and risks with acetanilide.—P.J. ii./96,14; B.M.J. i./98, 1539; B.M.J. ii./98,434,987; L. ii./11,777.

Danger of Acetanilide as headache powders.—Dixon, P.J. ii./12,555. When first introduced two 5 grain doses at some hours' interval produced cyanosis.—L. ii./10,575. See also L. i./13,1491.

Effect of other drugs on toxicity of Acetanilide :—

Caffeine is of very little value in combating the heart distress of Acetanilide poisoning. Sodium Bicarbonate has, however, much greater power in this direction; this probably prevents the whole dose of the drug entering at once into the blood. The toxicity of acetanilide is increased by Codeine and Morphine.—L. i./09,1706; ii./09,1189; P.J. i./09,869.

ACIDUM BENZOICUM.

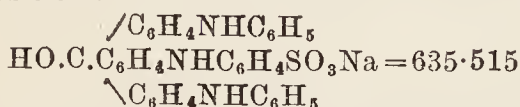
Tests.—Should not develop odour of benzaldehyde when warmed with its own weight of potassium permanganate and ten times its weight of dilute sulphuric acid (*Off.* test for cinnamic acid). Solution in sulphuric acid when gently warmed should not turn darker than light yellow.—U.S. M.Pt. 120—122° C.

USE AS PRESERVATIVE.—The Acid and Sodium Benzoate are not harmful if used in moderate amount. 0.1% is sufficient to preserve meat and butter. 0.05% is sufficient in fruit and fruit syrups.

Detection of, in Foodstuffs.—Extract with a mixture of ether and petroleum ether in equal parts; this evaporated may contain saccharin (taste), salicylic acid (by its colour with ferric chloride), and benzoic acid—recognised by odour, crystalline form, and conversion into aniline blue by heating with Rosaniline and Aniline. This is Triphenyl-Rosaniline, $C_{33}H_{33}N_3O = 547.384$ or $C_{26}H_{16}(C_6H_5)_3N_3(?) = 529.468$. Its Hydrochloride is called **Opal Blue**, *Syn.* **Spirit Blue**, being soluble in spirit.

Water-Soluble-Blue is obtained by converting Spirit Blue (above mentioned) into Triphenyl-Rosaniline-Trisulphonic Acid by treatment with Sulphuric Acid, and is usually supplied as the Ammonium Salt. (Simpson.)

Nicholson's Blue, *Syn.* Alkali Blue is the Sodium Salt of Triphenyl-Rosaniline-Monosulphonic Acid made by sulphonating Spirit Blue, almost in the cold, composition :



Nicholson's Blue is dyed on wool or silk from a slightly alkaline or neutral bath. The goods are washed and then developed in a bath acidulated with Sulphuric Acid. The ordinary water-soluble blues dye from an acid bath.

Dried Cranberries contain as much as 0.45% Benzoic Acid.—L. i./09,1701.

Siam Benzoin.

The only source of Siam Benzoin of commerce is *Styrax Tonkinense*, Craib, found in the district between Luang Prabang and Hanoi. *S. Benzoides* of N. W. Siam yields a fragrant resin, but it is not certain that it enters commerce. The method of preparation with hog's marrow would account for the characteristic appearance of Siam Benzoin.—E. M. Holmes, P.J. ii./13, 802,804. See also P.J. i./07,127; ii./12,777.

Friars' Balsam.

Fryer's Balsam or Jesuits' Drops were mentioned as early as 1725 by Pomet, who obtained the recipe from the English translation of "Mr. Pimodan, King's Lieutenant of Toul in Lorraine."

James in his "English Dispensatory," 1747, said that Balsam Traumaticum of the London and Edinburgh Pharmacopœias was in imitation of Jesuits' Drops as used in private families and much celebrated abroad as Baume de Commandeur de Berne. Acts of Parliament from 1785 to 1812 mentioned it as Grubb's Fryars Drops, Fryers Balsam, etc. Alpe in 1888 gave a formula containing calomel, purging antimony, guaiacum wood, balsam of Peru, extract of hemlock, sugar candy, oil of sassafras, tartaric acid, and gum arabic in spirits of wine.—C.D. i./13,661.

ACIDUM BORICUM.

Boron has an abnormal value in its temperature co-efficient of resistance. A small piece of fused Boron mounted in series with an electric lamp obstructs nearly all the current, but on warming the Boron the resistance is reduced and the lamp lights. A filament of Boron at ordinary temperatures will show a resistance of 5,620,000 ohms, but when warmed to a dull red heat the resistance drops to 5 ohms. A splinter of Boron is almost as hard as a diamond. It will easily scratch the very hard substance Carborundum—L. ii./12,1822.

Lead as impurity is of importance. *Off. limit* is 25 parts per million.

Detection of Boric Acid. See *Milk Analysis*, p. 453.

Detection of minute traces of Boric Acid by Tincture of Mimesa Flowers made by warm maceration (10 minutes on water bath) of 5 Gm. first in 50 Cc., and then with 40 Cc. Alcohol 95% after decanting.—For details *vide* P.J. i./14,31.

Manna can replace Glycerin in the titration of Boric Acid.—L. E. Iles, Analyst, 1918, 43, 323.

Glycerinum Acidi Borici.

The reaction between Boric Acid and Glycerin leads, it is thought, to the formation of Glycerol-Boric Acid, a mono-basic acid with formula:—

**Sodii Biboras. Borax.**

Arsenic (*Off.*) Limit is 5 parts per million. Lead the same.

Sodium Perborate. Estimation of available oxygen in, and Perborate Soap Powders. A volumetric method based on the reaction $NaBO_3 + CaOCl_2 + H_2O = NaH_2BO_3 + CaCl_2 + O_2$ found best.—H. Trickett, C.D. '20, 283.

ACIDUM CARBOLICUM.

Quantitative Estimation of Phenol.—This may be effected by converting it into Tribromphenol $C_6H_2Br_3OH$:—

Dissolve Phenol 1.567 Gm. in water sufficient to make 1000 Cc. Place 25 Cc. of the Solution in a 200 Cc. stoppered bottle, add 30 Cc. of N/10 Bromine Solution (**Koppeschaar's Solution**) and shake repeatedly for half an hour, then add 5 Cc. of 20% Potassium Iodide Solution, shake well, add 1 Cc. Chloroform and titrate excess of Iodine with N/10 Thiosulphate. Subtract the number of Cc. required from thirty: the remainder equals the number of Cc. N/10 Bromine used up. This multiplied by 4 gives the percentage of absolute Phenol (*i.e.*, 1 Cc. N/10 Br. = 0.001567 Gm. Phenol).

The process works satisfactorily,—we obtained with a sample of detached crystals (M.Pt. 41° C.), 98% as an average of three determinations.

Koppeschaar's Bromine Solution is made as follows:—

Dissolve Potassium Bromate 3.2 Gm. and Potassium Bromide 50 Gm. in Water 900 Cc. To standardise place 20 Cc. in a 250 Cc. bottle with Water 75 Cc. and 5 Cc. Pure Hydrochloric Acid. Shake a few times, quickly introduce 5 Cc. of 20% Potassium Iodide Solution and titrate the Iodine set free by N/10 Sodium Thiosulphate. Dilute the Bromine Solution so that equal volumes of it and the N/10 Thiosulphate exactly correspond in the conditions of the test.—*c.f.*, U.S. IX., p. 558.

Excretion of Phenol after poisoning by.—Dublin Jt. Med. Sci., May, 1914. L. i /14,1585.

Tribromphenol-Bismuth.—Evans finds 62 to 65% as yield of Oxide and appears to favour the formula $\text{Bi}_2\text{O}_2\text{OH}(\text{OC}_6\text{H}_2\text{Br}_3)$. They find usually 2 to 3% soluble in alcohol and in water. Compare our investigations, Vol. I., p. 20, *et seq.*

Direct estimation of Bismuth in.—B.P. Conf., 1919.

Phenololipoids.—Compounds of Phenol with various lipoids such as egg yolk, cerebral substance, cholesterine and lecithin with camphor as the connecting link. The phenololipoid known as ‘H’ is a combination of phenol, cholesterin and camphor, a homogeneous paste. Intravenous injections of 1·5 centigrammes per 100 Gm. body weight of guinea pig tolerated. This ‘H’ compound shows the parasitotropic action of phenol and the antitoxic action of cholesterine. It is, however, free from the organotropic action of phenol, having no local caustic action or anæsthetic properties. It realises in fact, the exact requirements of a chemotherapeutic agent.—C. Piazza abst. L. i./20,724.

ACIDUM CRESYLICUM.

The content in the Phenol-Cresol Fraction (185° to 195° and 195° to 205°) and the High Boiling Fraction (205°—250° and 250° upwards) vary within wide limits commercially.

We have combined some figures obtained by Evans with a recent fractionation of our own (Source M in the table):—

Source.	De-scrip-tion.	Phenol-Cresol Fraction.				High-Boiling Fraction.		Resi-duum
		(a) Below 185°.	(b) 185°– 195°.	(c) 195°– 205°.	Total (b) + (c).	205°– 250°.	250° Up.	
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
A	Pallid.	½	71	24½	95½	—	—	4
B	„	1	35	43	78	14(220°)	—	7
C	Crude	3½	1	4½	5½	44	22(330°)	25
C	„	4½	2½	6	8½	50(270°)	—	37
C	Nigrum	2	2	12	14	46	20(360°)	18
M		6	3	79	82	10(220°)	—	2

The figures are very instructive in view of the respective boiling points of *m*-, and *p*-Cresol. Compare *B.P.* and *P.G.* requirements, our Vol. I. 32.

ACIDUM HYDROCYANICUM.

Volumetric Estimation.—Titrate about 1 Gm. (accurately weighed and slightly alkaline with Sodium Hydroxide throughout the test), with N/10 Silver Nitrate Solution, until a permanent Silver Cyanide precipitate is formed. The soluble double salt, $\text{AgCN} \cdot \text{NaCN}$, is intermediate. $\text{AgNO}_3 = 2\text{HCN}$ or $\text{Cc. N/10 AgNO}_3 = 0.00537 \text{ Gm. HCN}$.

Borax Solution in excess is added to Hydrocyanic Acid before titration with Silver Nitrate. Suitable for Cherry Laurel Water.—P.J. ii./05,910.

The new official method gives practically the same percentage as the old soluble double salt $\text{AgNa}(\text{CN})_2$ method. The presence of chloride makes no appreciable difference. Excess of alkali causes only a slight error.—B. Dott, P.J. i./16,368.

Volatility of Hydrocyanic Acid at ordinary temperature in an open vessel may be considerable.—*ibid.*

R. Leitch Morris has reviewed the various known methods. The B.P. process apparently uses too little Potassium Iodide. Three or four times the amount gives better result.—B.P. Conf., 1920.

Quantitative Estimation of Hydrocyanic Acid in the blood and tissues of animals post mortem. The method is colorimetric and depends on reaction between Potassium Cyanide and Picric Acid. [Liebig's *Annalen*, CX. p. 289 (1859)]. A Color Scale for comparison is made by mixing equal volumes of recently titrated 1/1000 HCN and Picrate mixture (equal volumes of 0.5% Picric Acid and 5% Sodium Carbonate). This stock solution (T 500) is further diluted (T 1, 2, etc.). The estimation is made by matching the color of the given fluid or of its distillate into Picrate Mixture with that of the color scale.—A. D. Waller, *Phys. Proceedings* June 18, 1910.

Detection of Traces of Hydrocyanic Acid.

A comparison has been made of the delicacy of the Prussian blue as compared with the picrate test for hydrogen cyanide, from which it appears that the former is of at least equal delicacy to the latter.

By evaporating the Alkaline Cyanide Solution to almost complete dryness, adding 2 per cent. Ferrous Sulphate, leaving *in the cold* for ten minutes and acidification, evidence of the presence of 0.000002 gm. of HCN may be obtained. The Ferro-Cyanide reaction may be used for the detection of Hydrogen Cyanide in the blood and brain of poisoned animals with equal efficiency to the Picrate method as applied to the same purpose by Waller.—G. D. Lander and A. E. Walden. *Chem. News*, May 19/11, p. 240.

See also Water Analysis chapter.

Delicate Test for Hydrocyanic Acid.—A few drops of phenolphthalin solution made alkaline with Sodium Hydroxide added to liquid to be tested. If red colour be produced on adding Cupric Sulphate Solution 1 in 2,000 (due to oxidation into phenolphthalein) Hydrocyanic Acid is proved to be present.

Phenolphthalin is made by reducing phenolphthalein with Zinc in alkaline solution.—P.J. i./05,721.

Method of Horticultural Use.—Employing Sodium Cyanide and acid.—P.J. ii./08,722.

Hydrocyanic Acid is used for fumigating ships containing grain, foodstuffs, etc.,—it is the best vermicide for the purpose, destroying rats, fleas, etc. It has no ill effects on dry grain, but moist food, *e.g.*, butter, milk, etc., is liable to absorb the gas. It has been used in South Africa to destroy vermin in railway carriages.—P.J. ii./12,804.

ACIDUM LACTICUM.

P. G. V. requires (with Sp. Gr. 1.21 to 1.22), about 75 per cent. of Lactic Acid and 15 per cent. of *Lactic Anhydride*, calculated as Lactic Acid. Assay-process: 5 Gm. of Lactic Acid is diluted with water to 50 c.c., 20 c.c. of this mixture is neutralised with N/1 KOH, using at least 16.6 c.c. of test-solution (=74.7% of Lactic Acid). The neutral liquid is warmed for one hour on the water-bath, after adding 10 c.c. N/1 KOH. For neutralisation, 6.7 c.c. of N/1 HCl should be required = 15% Lactic Anhydride, calculated as Lactic Acid, 0.09005 Gm. of which corresponds to 1 c.c. N/1 KOH (using phenolphthalein as indicator).

The *Off. Acid* is similar with not less than 10% of the Anhydride (Lactide). Lead should not exceed 10 parts per million.

ACIDI LACTICI BACILLI.

Lactic Acid Bacilli Preparations.

Prof. Elie Metchnikoff, in his work "The Prolongation of Life," evolved a theory of arresting the growth of putrefactive (alkaline) organisms in the intestines, and hence stimulating intestinal digestion and diminishing toxic absorption from the bowel by acclimatising the (harmless) Lactic Acid Bacillus. He takes as his starting point that the newly-born infant has sterile intestines and on partaking of the first drop of mother's or cow's milk these commence to be infected. He then discusses the evils resulting from putrefied food, some of the recipients dying from the effects; others if their resistance be sufficient, saving their lives after experiencing a severe attack of cholera. The word 'acid' makes its appearance—*i.e.*, in connection with the custom prevailing from early times of preserving food with vinegar—the product of bacteria to 'ward off putrefaction.' It is further pointed out that sub-

stances themselves producing a preservative acid—*e.g.*, milk,— can be made into others—*e.g.*, cheese—which can be kept for longer or shorter periods of time. 'Kwass,' of which black bread is the main ingredient, is the chief beverage in Russia in the summer. It contains Lactic Acid. Other instances are given with the conclusion, Why not arrest putrefaction in the digestive tract as with the conserve?

Experimental consumption of large quantities of Lactic Bacilli showed that intestinal putrefaction was diminished.

It was found that with a normal diet the *Bacillus* appeared in the stools in three to four days after it had been begun to be consumed regularly with the food; that it took eight days to become properly acclimatised in the intestine, and that when this had taken place it would continue to live and thrive for twelve more days without another dose being swallowed, afterwards gradually disappearing. Regular administration caused increase in weight and bulk of feces.

Lactic Acid, as such, has been employed for years past in dyspepsia, enteritis, &c., as also in diabetes, and locally in tuberculous ulceration of the larynx.

The conclusion was that as organisms of putrefaction only increase with difficulty in neutral or acid media, the most feasible procedure would be to introduce a Lactic Acid organism (growing in a sugar medium) into the human being to arrest the proliferation of harmful bacteria. The bacillus known as the **Bulgarian Bacillus** (*B. Caucasicum*), isolated by Cohendy and independently by Massol from 'Yoghourth,' a form of soured milk, was deemed most suitable, as it is the best acid producer. The acid it produces is the optically inactive variety. It is a hardy organism resisting the stomach juices and its own acidity to a marked degree.

According to Hewlett it occurs apparently in various forms. In natural soured milks for example:—

- (1) *B. Bulgaricus* and *B. Massol* from Bulgarian Yoghurt and Maya.
- (2) *Streptobacillus lebenis* from Egyptian leben.
- (3) *Bacillus Mazun* from Armenian mazun.
- (4) The "Granule" bacillus from Bulgarian Yoghurt
- (5) *Bacterium Sardons* from Sardinian Gioddu (grixoni)
- (6) *Bacterium Lactis Acidi* (Leishman).

are probably varieties of only one species.—B.M.J. ii./10,1584; L. ii./10,402.

Buttermilk in many countries, **Kephir** or **Koumiss**, *vide Vol. I. p. 574*, the Egyptian 'Leben Raib,' 'Prostokwocha,' and 'Varenetz,' of Russia, **Yoghourth** (Yohourth) of the Balkans, and many others were forerunners of the curdled milk treatment, which attracted so much attention. It is believed that the Bulgarian peasant consumes as much as 10 Gm. of Lactic Acid daily in his diet of Yohourth.

Kephir Fungus or grains occurs in small yellow nodules. A recent bacteriological examination showed the presence of Lactic Acid Bacilli with a few yeast organisms and practically no cocci.

These sour milks, as a rule, contain yeasts in small proportions, and *ergo* alcohol—the same remark applies to the artificially soured milks.

According to Emerson the presence of a carefully selected strain of yeast is a useful therapeutic aid in many affections.

The **Bulgarian Bacillus**, according to Metchnikoff, will produce as much as 2.5 Gm. of Lactic Acid per 100 Cc. of milk.

Succinic, acetic and formic acids are also formed by it in small quantity. This bacillus has no action on albuminoids (casein, &c.) nor fats, nor does it produce alcohol or acetone. It does not attack saccharose (cane sugar) or maltose; it is therefore useless to add cane sugar in the hope of increasing Lactic Acid yield. For flavouring purposes the *B. paralactic* (*B. Guntheri*) is used in conjunction.

Gunther's Bacillus is found in abundance in all spontaneously coagulated milk and is an important Lactic Acid producer.

It modifies the condition of the curd formed, and hence is a useful addition, but it appears to die out in the finished product. It produces pure dextro-rotatory Lactic Acid (no other acid) from grape and milk sugar.

Huppe's Bacillus is another Lactic Acid organism.

It is almost always present in milk which has soured spontaneously. This organism, sometimes called specifically the *B. Acidi Lactici*, differs from *B. Guntheri*, by its comparative ease of cultivation upon ordinary nutrient media.

The characters of the chief Lactic Acid organisms may be tabulated:—

ORGANISM AND SYNONYMS.	APPEARANCE.	PROPERTIES.
<i>Bacterium Caucasicum</i> (Kern); <i>syn.</i> Massol's Bacillus, <i>syn.</i> Bouchard's Bacillus, <i>syn.</i> Bulgarian Bacillus.	Large square-shaped, 5 to 6 μ \times 1 μ showing vacuoli, slightly motile. + Gram staining.	Appears to take a little time to establish itself, but ultimately is the omnipresent bacterium in milk. It is a strong lactic acid producer.
Hüppe's Bacillus: <i>syn.</i> <i>B. Acidi Lactici</i> . <i>Streptococcus Lebenis</i> may be closely allied.	Coccoid shape 0.4 to 0.6 μ \times 0.6 to 2 μ . Usually in pairs, rarely longer chains, non-motile. + Gram staining.*	Causes bitterness, breaks up fat and proteolytic substances.
<i>Bacterium Guntheri</i> ; <i>syn.</i> <i>B. Acidi Paralactici</i> (Kozai).	Short rods, 1 μ \times 0.5 to 0.6 μ , with pointed ends, in pairs or short chains non-motile. —Gram staining.	Gives a smooth, non-leathery form of curd. It appears to be killed off to some extent in the curdling of milk, being probably ousted by <i>B. Caucasicum</i> .

* The **Huppe's Bacillus** with which we have worked has been found to stain well by Gram's method, but opinions differ.

TO INCREASE YIELD OF BACILLI IN SOURED MILK.

The only method of increasing the bacillary yield is to incubate for a longer time than the prescribed 10 hours, but this is probably better refrained from. *The bacilli at 10 hours' growth are in an active form capable of rapid multiplication*, and the curd is more slightly in appearance than if 'over-made' with excess of whey.

Methods of Examination of Lactic Acid Bacilli Preparations.

1.—ORGANISMS PRODUCED AND CURD FORMATION.

Loopfuls of the milk, treated with a crushed Lactic Acid Bacillus tablet (*vide* Vol. I.), are to be examined after ten and twenty-four hours' cultivation.

The best **Staining Method** to employ is that of Gram *q.v.*, using 1% neutral red as counterstain. The Gram-staining organisms take on a deep violet, and the rest of the field is a reddish pink, less diffuse than that with eosin, which is often used as a counterstain. A copious growth of *B. Caucasicum* is essential, with exclusion of other bacteria. Curd formation should also be satisfactory.

The property of producing lactic acid is common to a vast number of organisms.

2.—ESTIMATION OF LACTIC ACID.

The Pasteur Institute found in soured milk, made according to Metchnikoff, 1% of lactic acid when ready for consumption. More is formed if longer time is allowed (*vide antea*).

The amount obviously depends on the content of lactose, the average of this constituent being 4 per cent. The decomposition of lactose in milk into lactic acid is a complex matter. In any case nature will not allow an optimum yield, as the bacilli kill themselves by the acid they produce—the maximum acid formation being reached in about thirty-six hours.

It is, however, not so much a question of the quantity of acid produced as the assurance that the culture used is active and capable of thoroughly establishing itself in the intestines to the exclusion of harmful bacteria, as evidenced by bacteriological examinations of the excreta.

The maximum amount of lactic acid formed in ordinary conditions (from milk) appears to be about 0·8 per cent.

Milk, it should be noted, is amphoteric in reaction on account of its content of alkali phosphate. Phenolphthalein can be used as an indicator in titrating, but the end reaction is a little difficult to determine—it requires to be carefully looked for: 20 Cc. of the milk is a convenient quantity to titrate, using $\frac{N}{10}$ Soda.

For details of CASEIN RENDERED SOLUBLE and PHOSPHATE RENDERED SOLUBLE, during fermentation, see a paper by the author, 'Lactic Acid Organisms.'

It appears that in the district around Milan spontaneously curdled milks are not used to any extent nor milks prepared by special ferments. In Sardinia, however, the people prepare and make a continuous diet of (for lack of anything better) Gioddu Mezzoraddu, or Miclaratu, which are the products of fermentation due to *Saccharomyces Sardons* and to *Bacillus Sardons* and *Mazun*, and which resemble in composition the Lebenraib of Egypt, the Prostokwacha and Varenetz of the Russians, the Kephir of the Caucasians, the Koumiss of the Tartars, and the Mazun of the Armenians. At Milan the grape ferment is in demand, at Turin Blastoinvertin (*Saccharomyces invertens*) in Lombardy Kephir, and at Piedmont the true Yoghourt.

From Greece we learn that Yoghourth is much in use both as a food and for therapeutic treatment. It is prepared there by adding a little lemon-juice to fresh milk, which is then kept warm for eight hours, forming a curd which is the first stage in the manufacture. From the curd thus formed a tablespoonful is mixed with boiled milk, and this procedure is repeated several times, with fresh milk on each occasion, until a Yoghourth of suitable consistence is obtained. Small spoonfuls of this latter product are added to wooden or earthenware pans containing milk which has been boiled and is still slightly warm. This forms the commercial Yoghourth, which curdles in four hours at 35°C. It has at first a sweetish taste, becoming extremely acid after twelve hours. In order to keep it, which one may do for as long as from five to eight days, it is poured into little bags of cotton from which the whey filters, the product thereby becoming thicker and of better-keeping qualities. Yoghourth prepared from sheep's milk is highly esteemed as a milk-food by the Greeks.

Vaginal Suppositories of Lactic Acid Bacillus.—A hard gelatin capsule (No. 11) is filled with Syrupy Glucose—one daily for gonorrhœa. Upon decomposition of the glucose acid is formed in which the large *Bacillus Doderlein*—a normal inhabitant—can grow. The acid kills off the pathogenic bacteria.—P. H. Marsden, P.J. i./20,365.

REFERENCES TO LACTIC ACID BACILLUS THERAPY.

Arranged chronologically as far as possible.

Ribbert of Bonn confuted Metchnikoff's theory, and said senility is not accounted for by toxic absorption from the colon. Asks for evidence of long life of birds which have no colon.—B.M.J. ii./08,525.

Metchnikoff found *B. putrificus*, *B. Sporogenes*, and *B. Welchii* (*B. Aerogenes Capsulatus*) inhabitants of the large intestine.—B.M.J. ii./09,1024.

Suggestions that various ferments produce the various forms of Acid (+, - and o) and that *B. Coli* is adversely affected by one form and not by another.—Glover—L. i./09,133.

Necessity of boiling milk on two successive days. Perhaps better to discard milk altogether and employ a liquid sugar medium. Peptone water seems to be an essential of any form of the latter. A culture administered in an acid broth desirable. Freshly made cultures should be employed when the Lactic therapy is indicated. Opinion is expressed that the gastric juice kills bacteria with ease. Lactic ferments are devitalised.—B.M.J. i./09,711.

It is interesting to consider the changes which may be expected during treatment. In the first week slight diarrhœa may occur, with flatulence and colicky pains; headaches have also been observed at this stage. In the second week there is often constipation, and cases of chronic constipation become aggravated. Constipation disappears during the third week, the bowels become regular, and there is progress toward recovery. The ethereal sulphates in the urine are said to diminish, and in the fourth week the harmless colon bacilli begin again to predominate in the stools.

Periodic examinations of the stools should be made during treatment, in litmus milk containing 3.5 parts of lactic acid per litre, incubating at 37° C. In this medium hardly anything will grow except the bacillus of Massol. The litmus remains coloured pink unless organisms are present which can neutralise acidity. About two and a half months is requisite to completely transform the intestinal flora.—L. ii./08,372.

Soured milk; its nature and uses.—Hewlett, Nat. April 7, 1910, 159.

The useful role of the lactic acid consists in preventing changes in the proteins beyond a certain point. Once established, the lactic bacilli counteract the action of such bacteria as *B. Coli*, which splits up proteins beyond the desired limit, with production of toxins, etc., and diminishes the amount of nutrition supplied to the blood.—L. ii./08,958.

Chronic arthritis.—Herschell found considerable improvement results from combined treatment with Lactic Acid Bacillus Therapy and Ionisation. The latter consisted of 50 m.a. current for 40 minutes three times a week using Potassium Iodide 2% solution driven in at the negative electrode and at the + pole 2% Lithium Citrate. At each sitting the relative positions of the electrodes were reversed.

Symbiosis in nature plays a large part in the destruction of infective organisms—by crowding out. The fact that the lower animals do not become infected through the digestive tract with typhoid and cholera is ascribed by Metchnikoff to this symbiosis.—Hewlett.—L. i./09,743.

Lactic Acid Bacilli are aerobic, hence better to sour the milk before taking it.—P.J. i./09,361.

In the knowledge of the writers a patient suffering from nervous dyspepsia very susceptible to drugs, debarred wines, saccharin, stimulants, etc., under three weeks treatment with "Trilactine" found acidity and flatulence to disappear though taking sugar, but, whether due to the treatment or not, he noted decrease in colour of complexion. At first there was a slight tendency to constipation. He noted stoutness (excess of fat) to decrease, but weight to increase. No other form of acid had ever been tolerated. In general, the treatment was thought beneficial.

A medical man suffering from a violent attack of ptomaine poisoning resulting in acute distension, was in our knowledge completely cured by a two days' course of sour milk.

Similarly a case of cystitis with the urine teeming with *B. Coli* was freed from the infection by the aid of the treatment.

A patient suffering from rheumatism stated he received much benefit.

Appendicitis may be warded off. The caecum becomes inflated with the gas produced by intestinal putrefaction, the valves at the apex of the vermiform appendix become separated and allow entrance of faecal matter to set up the septic irritation of appendicitis. Lactic Acid Bacilli may supersede the abnormal organisms and prevent necessity of an operation. The bacilli will go on producing the acid in the internal economy. Possibly gout, due to a specific organism, and rheumatism ascribed to uric acid, as also stiff neck (fibrositis) and skin diseases, both due to absorbed toxins, will disappear under the treatment. Lactic Acid Bacilli treatment may prevent erosion of the palate by *Leptothrix buccalis* and as lactate of lead (from milk and liquor plumbi) Lactic Acid cured a case of dermatitis repens when other remedies failed.—Campbell Williams.

Colitis treated with curdled milk much benefited.—B.M.J. i./09,763.

In sprue (an acid producing complaint) Cantlie found increased acidity of faeces at commencement and that the sprue conditions became worse, but on giving alkali subsequently there was improvement. Probably the Lactic Acid Bacilli stirred up the existing passive intestinal fermentation to activity, which is then cut short by the alkali.—B.M.J. ii./09,776.

"*B. Caucasicum* resists gastric digestion, reaches the intestines alive and establishes itself as a part of the intestinal flora with a limited life of a few weeks, becoming a facultative anaerobe living on the culture medium provided by the food of the individual."—G. Herschell.

Metchnikoff says "that if it be true that our precocious and unhappy old age is due to poisoning of the tissues (the greater part of the poison coming from the large intestine, inhabited by numberless microbes), it is clear that agents which arrest intestinal putrefaction must at the same time postpone and ameliorate old age."

In acute nephritis milk is the traditional diet. It does not cause alimentary fermentation except perhaps Lactic Acid fermentation, which may be advantageous in counteracting alkaline putrefactive agents in the colon. Typhoid fever treated with very gratifying results.—L. i./10,30.

Midway between incredulity and over-laudation there is good evidence of real dietetic and medicinal value in fermented milk.—“The Times,” A Leader, April 29, 1910.

Typhoid treated with gratifying results. In ulcerative colitis especially recommended.—B.M.J. i./10,19.

The great advantage of giving Lactic Acid Bacilli is that they form Lactic Acid where it is wanted—antiseptics given by the mouth are little likely to be effective in the intestines. During first four days of treatment the patient should be on carbohydrate diet, with fair quantity of Malt Extract. Great benefit in mucous colitis, in uræmia and diabetes.—O. Leyton, B.M.J. ii./10,289, 1583; L. ii./10,401.

Goodbody found no alteration in the chemistry of the fæces. Aromatic Sulphates were apparently not diminished.—B.M.J. i./10,21.

Eyre and others noted that successive cultivations from the fæces during treatment showed rapid disappearance of pathogenic organisms concerned.—B.M.J. i./10,21. Vaughan Harley, on the other hand, conducted experiments which convinced him that the bacilli taken by the mouth reduced alimentary putrefaction. Fæces lose their alkalinity and Indican and Ethereal Sulphates in urine seem reduced.—B.M.J. ii./18, 289, 1588. Sour milk is a complete food unusually easy of digestion.—L. ii./10,402.

Whey recommended as a medium for lactic acid treatment because the complicating influence of the Casein is eliminated.—L. ii./10,402.

None of the “dry preparations,” *i.e.*, tablets, sweetmeats, etc., not even the cheese form, has given results in any way comparable to those obtained by the administration of properly prepared soured milk. Soured milks beneficial in proportion to their degree of sourness.—L. ii./10,198. Beneficial results thought to be due to the acid not to the organisms. Experiments on the inhibitive action of the acid on the coli group of organism promised. A syrup recommended for use which, when diluted with aerated water, shall contain 1% acid.—L. ii./10,197. Cultures of Lactic Ferments and their uses.—Pres. Nov. 1911, p. 282.

PREVENTION OF DENTAL CARIES. The real exciting causes are fermentative bacteria producing local acid fermentation by decomposing carbohydrate foods. It is well known that Acid (Lactic or Acetic) when it reaches a certain definite concentration inhibits the activity of the bacteria which produce it, and as dental caries is never a disease affecting the whole surface of the teeth at once the best method of prevention is thought to be acid lotions with some antiseptic, *e.g.*, Carbolic Acid. Suggestion was made to, if possible, combat dental caries by crowding out the acid producing organisms by others less virulent so far as dentine is concerned. Cultivation of some innocuous form of organism had been used—the spores of the selected organisms being freely sown about the mouth and from time to time the number present was increased by the use of lotions containing a pure culture of the organism. Treatment of rampant caries in this way had given excellent results.—Sir K. Goadby, L. ii./10,562.

The whole treatment appeared, according to Hewlett, to be valueless, as the ingestion of soured milk for a month produces no decided change in the numbers of lactose fermenters and of *B. Welchii* in the fæces. *B. Bulgaricus* undoubtedly passes into the intestine.—B.M.J. ii./10,1584.

Metchnikoff in a later paper stated that Senility is attributable largely to poisons, aromatic bodies, Indols and Phenols of the intestinal flora. Diet should be arranged to reduce these bodies. Lactic Acid Bacilli are necessary to overcome toxin-forming microbes.—N. Y. Med. Jl., July 13, 1913, p. 80.

Amongst the highly beneficent organisms in the intestinal flora, in the French view, are the acetogenic organisms and of these in particular the *B. bifidus* of Tissier (Anaerobe and Gram +).

In diabetes mellitus the antiseptic and corrective action of *B. Caucasicum* overcomes auto-intoxication. The potency of the bacillus to make Lactic Acid is of value in stimulating the duodenum and upper part of the small intestine.—J. W. Beveridge, N.Y. Med. Jl., July, 1913. A lowering of the output of glucose observed.—P. Horowitz, Med Record, Mar. 9, 1912.

In goitre fresh cultures of Lactic Acid Bacilli in milk ($\frac{1}{2}$ to 1 pint) *per diem* gave striking results. The thyroid gland showed evidence of diminution the tenth day after commencing treatment. Patients lost flesh—the same occurs under Thymol and Iodine.—Major R. McCarrison, L. i./13,369.

Indol is produced by Coliforms and only to a small extent by the putrefactive Anaerobes (*B. putrificus*, *B. Perfringens*, *B. Sporogenes*, etc.). Ledingham remarks it is surprising that Metchnikoff should have drawn so much attention to the Anaerobes as the chief factors in intestinal putrefaction while at the same time devoting so much energy to the investigation of the toxic action of Indol—a product chiefly of coliforms. The conclusions are contrary to the researches of the Metchnikoff school.—L. i./13,1153.

Sprue has been well treated by the tablets—given after a milk meal.—Lovell Drage.

ACIDUM PHOSPHORICUM.

Off. Assay Method.—A process is given for titrating with N/1 Sodium Hydrate in presence of Sodium Chloride. Lead limit 10 per million. Arsenic 5 per million.

U.S. IX. requires 85 to 88% pure. In the U.S. Assay method N/10 Silver Nitrate Solution is added a neutralised weighed quantity, and the excess of silver after filtering from the precipitate is determined by means of Sulphocyanide.

Detection of Arsenic Acid in presence of Phosphoric Acid.

The solution of the alkali salts of the two acids, rendered faintly acid with Acetic Acid, is reduced to small volume, and treated with 10–15 Cc. of a concentrated solution of Ammonium Nitrate. Raise to boiling and add about 1 Gm. of Ammonium Molybdate. When this has dissolved, the liquid is boiled for about $1\frac{1}{2}$ minutes. If Arsenic Acid is present a white precipitate forms. By this method 0.002 Gm. of Arsenic Acid can be detected in the presence of a large quantity of Phosphoric Acid. Salts of Ca, Sr and Mg. do not invalidate the test, but render it rather less delicate.—J.C.S.A. ii./10,896

Metaphosphoric Acid HPO_3 = 80.048 is equivalent to *Glacial Phosphoric Acid*, and is employed as an Albumin Test. (*vide Urine*).

Pyrophosphoric acid is formed as an intermediate compound in the hydration of metaphosphoric acid. The hydration does not take place according to any simple scheme, and a method of estimating meta acid in a solution of all three varieties by means of barium chloride is described. From the depression of the freezing point of aqueous solutions of various varieties of pyro and meta acids, it appears that when these acids are prepared by dehydration of orthophosphoric acid there occurs association of the molecules, but when prepared by decomposition of the lead salts by hydrogen sulphide simple molecules result.—Myers & Hold, Manch. Phil. Soc. per Na. March, 11, 66.

ACIDUM SALICYLICUM.

Use as Preservative.—Its use as food preservative has the disadvantage of sometimes giving the odour of phenol. **Detection of.**—Concentrate liquid (distil off any alcohol) in presence of Alkali and Sodium Chloride, acidify and shake out with Chloroform, evaporate and add Ferric Chloride Solution—red colour. Its use to preserve foods, where otherwise rapid decomposition would occur in hot weather, is upheld by some—personally we do not favour its employment. *See also Organic Analysis Chart.*

A Departmental Committee inquired into use of preservatives and colouring matters added to foods. Not more than one grain per pint of liquid and 1 grain per pound of solid food is permissible. The presence of Salicylic Acid may impair digestion, but is said not to be injurious. Cf. **Acidum Benzoicum**.

Self's Vanadate Test for Salicylic Acid.

Mix equal parts by volume of 40% Formaldehyde and Conc. Sulphuric Acid and cool the mixture thoroughly. Moisten the substance to be tested in a dish with the mixture, add a little Ammonium Vanadate and stir well. If Salicylic Acid is present a Prussian blue colour appears immediately changing rapidly to greenish blue, and finally green. For about 1 mgr. of Salicylic Acid use two drops of the liquid and 2 to 3 mgr. of Ammonium Vanadate. The only other substance giving the colour is Salicylic Aldehyde.—P.J. i./15,521.

Antiseptic Power *see* Chapter on.

ACIDUM ACETYL-SALICYLICUM.

New Test for Aspirin and its Derivatives.—V. Arreguine and E. D. Garcia (Ann. Chim. Analyt., No. 2, 1920, abst. C.D. Oct. 2/20, 1364), depending on the formation of *B*-methyl-umbelliferone by interaction with Resorcin. A very small amount responds. In some work on the subject we dissolved 0.1 Gm. Aspirin in 100 Cc. dilute Alcohol, and used small quantities of this solution for the test.

Mix 0.1 to 0.2 Gm. Resorcin with 2 or 3 Cc. of a solution of aceto-acetic ester in concentrated hydrochloric acid (1 Cc. in 10 Cc.) in a test tube. 1 Cc. of the above Aspirin solution is added (equiv. to 0.001 Gm.) and the mixture boiled for a few minutes and allowed to cool. A small amount of water is added and the whole made alkaline with ammonia. A beautiful blue fluorescence is produced.

We repeated the test using 0.1 Cc. of the Aspirin solution (equiv. to 0.00001 Gm. of Aspirin). The blue fluorescence in this case is remarkable, considering the small amount of Aspirin present.

On repeating the test *without* Aspirin we found the blue fluorescence also appears to a slight extent. It would be necessary therefore to do this control alongside for comparison.

Tests for purity of Acetyl-Salicylic Acid and its Salts.

A solution yields a buff-coloured precipitate with Ferric Chloride until hydrolysed by the addition of a little Hydrochloric Acid, which yields the typical violet colour of Salicylate (developing particularly on warming).

Ferric Aceto-Salicylate is hence less soluble than the Salicylate.

The Ferric Chloride Test for *free Salicylic Acid in Acetyl-Salicylic-Acid* is inefficient to prevent adulteration, *etc.*, in that the addition of Borax, Sodium Phosphate, Tartaric Acid, Citric Acid and other Oxy-acids will readily prevent or mask the colour ordinarily produced with Ferric Chloride.

Excepting for this point, the test is very useful for observing hydrolysed acid. We have used it in the following investigation. Quite recently (since Aspirin has been made in this country) modifications of the test have been employed to determine the purity of the compound—see page 13.

Liberation of Salicylic Acid from Acetyl-Salicylic Acid and its salts in dilute Acid and in Water.

We conducted a large amount of experimental work on this subject in 1911.

Acetyl-Salicylic Acid is commonly stated to be therapeutically active only when reaching the intestines which it is said to do unchanged—this statement being doubtless based on the assumption that it is more readily decomposed by alkalis. In 1903 experiments by another investigator indicated that there is distinct decomposition in presence of the acidity of the stomach. It was found that agitated with water at 17° C., it is not decomposed into Salicylic and Acetic Acids immediately, but that the hydrolytic action of the water can be recognised after an hour's contact.

Trituration before treatment with water appears to facilitate the decomposition. At 37° C. the hydrolysis is more evident, while with artificial gastric juice—(Pepsin 1, Hydrochloric Acid 10, Water 500) hydrolysis is still more rapid, the acid becoming at least partially decomposed.

Our own work tended in the same direction as the above data. The Pepsin was eliminated from our experiments as it does not affect the matter.

Our observations were as follows:—

Hydrolysis of Acetosaliclyic Acid takes place slowly both in the presence of plain water and in 0.2% HCl. The amount of decomposition in each case was obtained by colorimetric estimation with Ferric Chloride, using 1 in 500 solutions of Salicylic Acid and Acetosaliclyic Acid.

After 1 hour at 37° C. 0.8% of Acetosaliclyic Acid hydrolysed in Water.

„	„	„	„	5.0%	„	„	„	0.2% HCl
„	2	hours	„	2.0%	„	„	„	Water.
„	„	„	„	5.0%	„	„	„	0.2% HCl
„	3½	„	„	2.6%	„	„	„	Water.
„	„	„	„	5.0%	„	„	„	0.2% HCl.
„	4½	„	„	2.8%	„	„	„	Water.
„	„	„	„	5.0%	„	„	„	0.2% HCl.

By boiling the Acid from the 4½-hours test for about 1 minute it gave 7.5% hydrolysed.

After 22 hours 13% hydrolysed in Water.

„ „ „ 33% „ 0.2% HCl.

And so on, gradually increasing. The hydrolysis is in direct proportion to time.

To ensure that the Ferric Chloride coloration should not be interfered with by presence of the Hydrochloric Acid, the comparisons were made with a 0.2% HCl. solution of Salicylic Acid, in the case of the HCl. solutions of Acetosaliclyic Acid. A further addition of 0.4% HCl. was required to decolourise the solutions. It was found that at least 2½% HCl must be present to discharge or prevent the colour completely working with a 1 in 1000 solution of Salicylic Acid only. This is probably due to mass action. Taking the case of 5% hydrolysis, the amount of Salicylic Acid would only be 1 in 10,000 and one would expect that less HCl would be required to discharge the iron colour than when the Salicylic Acid is increased ten times as in a 1 in 1000 solution.

In all probability in taking a dose of the Acid the proportion *split up in the stomach*, as the experiments show, does not exceed 5%, and the remainder is absorbed in the intestines.

Tunnicliffe demonstrated presence of Salicylic Acid in the gastric juice (syphoned off) ½ hour after taking 1 Gm. of the Acetylated Acid. Pancreatic juice also splits up the acid rapidly.—P.J. i./05,700.

R. Stockman, B.M.J. i./13,598, says that in presence of alkalis, *i.e.*, in the duodenum, the Acid is split up forming Sodium and other Salicylates. It is doubtful, however, whether the whole of it is thus changed, as it is a much more powerful analgesic than Sodium Salicylate, and this can only be accounted for by assuming that a part of it is absorbed as such unchanged. Patients agree that even in non-rheumatic affections it lessens pain. This is true only to a very slight extent in the case of Salicin or Salicylic Acid. We also hold that on reaching the intestine there must be a splitting up of the acid and the formation of Sodium Salicylate, however slight,

at this stage, either from the nascent Salicylic Acid previously formed in passing through the stomach or by the splitting up of the Acetylated Acid by action of the alkali.

The **general conclusion** of our investigation is clear, namely, that in taking a dose of Acetyl Salicylic Acid *the amount split up whilst passing through the stomach does not exceed 5% of the amount taken*. This small amount of liberated nascent Salicylic Acid passing on to the alkaline juice probably produces or commences the pharmacological action. The Salicylic Acid thus formed and the rest of the acetylated substance passing on unchanged—the latter after hydrolysis in presence of the alkali—are in all probability absorbed into the tissues as Sodium Salicylate.

Determination of Free Salicylic Acid.

Evans draws attention to the unsatisfactory nature of the B.P. method of *shaking* the crystals with water. A slight "greasiness" on the surface of the crystals due to their having been crystallised from some medium other than alcohol renders the method inadequate.

The following is suggested (see also A. J. Jones, C.D. '19, 402) :—

Dissolve Salicylic Acid 1 Gm. in Alcohol 60 Cc. and adjust to 100 Cc. with water. 10 Cc. of this solution may then be diluted to 1,000 Cc. for the standard, making 1 Cc. = 0.0001 Gm. Acid.

Dissolve 0.6 Gm. of the Aspirin to be tested in 9 Cc. of Alcohol (S.V.M.), dilute with water to 90 Cc. and mix well. Take two exactly similar Nessler glasses. Into one pour 60 Cc. of the solution, into the other the remaining 30 Cc., together with 3 Cc. of alcohol, and adjust to the volume of the first. This gives a difference of 0.2 Gm. of Aspirin in similar mixtures of alcohol and water. One Cc. of a 1% solution of Iron Alum is added to each, mixed, and the colour matched by adding standard salicylic acid solution.

We have tried this test. In the case in point 5.5 Cc. of Standard solution were needed.

Therefore the 0.2 Gm. of Aspirin was matched by 0.00055 Gm. free acid—*i.e.*, the sample contained 0.275% free Salicylic Acid.

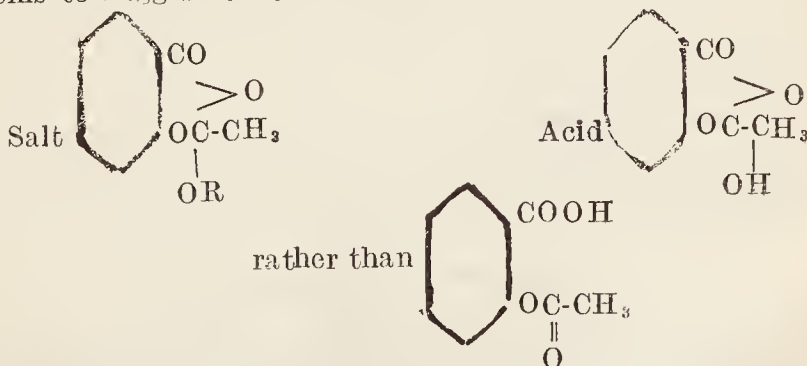
A sample of Tablets contained 0.31%.—W. H. M., 1920.

Limit of Free Salicylic Acid.—0.15% has been suggested as reasonable limit and 0.2% in tablet form. This seems to us rather stringent.

Determination of Free Acetic Acid. A. Nutter-Smith (B.P. Conf., 1920) described a process by which the sample (1 Gm.) previously finely powdered is spread on muslin and the Acetic Acid evolved is aspirated into 50 or 100 Cc. of Distilled Water for $\frac{1}{2}$ or 1 hour. The liquid is then titrated with N/500 Caustic Soda. Each Cc. of this representing 0.00012 Gm. Acetic Acid.

The B.P. Test, it is said, is not sensitive unless about 0.04% free Salicylic Acid is present.

It is remarkable that acetyl-salicylic acid is so unstable, and that from its salts free salicylic acid and an acetate should be produced on hydrolysis, and this seems to suggest that the formula may be



As a drug crave Aspirin may develop in the future. Prof. Wild, L.ii./20,35.

CALCII ACETO - SALICYLAS. *Syn.* *TYLCALSIN and
LITHII ACETO-SALICYLAS. *Syn.* *TYLLITHIN.

Hydrolysis:—

Working on lines identical with those used in the case of Acetosalicylic Acid *q.v.* in a lengthy investigation of the subject of the probable splitting up which occurs *in vivo*—the following amounts of hydrolysis were obtained:—

After 4½ hours at 37° C.		After 22 hours
Acetosalicylic Acid in 0.2% HCl.	5.0% hydrolysed;	33%
in Water	2.8% ; „	13%
Tylcalsin in 0.2% HCl	1.8% ; „	22.5%
in Water	4.4% ; „	41.2%
Tyllithin in 0.2% HCl	2.6% ; „	28%
in Water	5.3% ; „	56%

It is interesting to note that the amounts hydrolysed in the 4½ hours are slight in all cases and show no great difference. Hence the alkaline salts may be quite as useful in physiological action as the acid itself, and by reason of their greater solubility—in particular the calcium salt—should possess distinct advantage for prompt action.

At commencement of the test, *i.e.*, immediately on dissolving———

Aceto-salicylic Acid showed *no* hydrolysis.

Tylcalsin „ 0.6% „

Tyllithin „ 1.6% „

(The presence of Hydrochloric Acid does not interfere with the delicacy of the Ferric Chloride Test in the 22 hour results where the greater hydrolysis is seen. For colorimetry extremely dilute solutions are necessary,—the mixture had to be diluted 50 times, hence the Hydrochloric Acid only amounts to 0.004% and as already stated it requires 0.6% to prevent the colour. In any case the 22 hour results were only determined for corroboration,—we are concerned with the time the medicine would take to exert its physiological action—*i.e.*, in certainly less than 4½ hours.

For further details on Aceto-Salicylic Acid and its Salts see Vol. I.

Brunol.—Butyl Salicylate, soothing for local use to burns.—L. ii./20,506.

ACIDUM SULPHURICUM.

This Acid is used commercially for the production of glucose which enters into the manufacture of beer. Owing to it being made from Pyrites, it contaminated the glucose and thence the beer with arsenic in 1900. *Vide* also **Arsenium**.

Sulphur Dioxide and **Trioxide** in the products of combustion of coal gas are detrimental to health and to metal fittings, furniture, etc. Prior to 1906 Parliamentary restriction prevented the presence of more than 20 grains per 100 cubic feet. This restriction was removed with result that the content of Sulphur went up. The resulting gas was so detrimental that for their reputation the Gas Companies started partial purification again. Even now the content is 24½ grains per 100 cubic feet. The Sulphur in the gas is present as Carbon Bisulphide. The South Metropolitan Gas Company intend to supply the whole of their gas free from Sulphur compounds.—L. i./13,1270, 1503.

Sulphurous Acid in Coal Gas Products.—Estimation amounted to 0.002 mgr. per cubic metre of the gas—in addition to Sulphuric Acid.—P.J. ii./12,711.

Sulphuric Acid Manufacture, Theory of Reynolds and Taylor.—P.J. i./12, 486.

Volatility of Sulphuric Acid when used in vacuum desiccator has been found to be quite perceptible.—P.J. ii./13,497.

Sulphuric Acid, Solidified.

Sulphuric Acid mixed with 25% to 30% Kieselguhr becomes completely solid—suitable for transport.—P.J. i./13,206.

Sulphuric, Nitric and Nitrous Acids in admixture, Determination of.—P.J. i./13,469.

ACIDUM SULPHUROSUM.

Sulphurous acid is a strong reducing agent. For example, many colours are bleached by the sulphurous acid combining with the oxygen of any water present, hydrogen being liberated, which latter forms colourless compounds with the colours. These compounds may then be removed by washing.

The gas compressed in small cylinders was used for **Room Disinfection**, but Formalin (*q.v.*) is more used now.

"Clayton Gas," consisting principally of the residual nitrogen of the air, sulphurous acid up to 15%, and a considerable amount of sulphuric acid (which is useful, as it renders the gas visibly opaque) has been employed for freeing ships' holds from vermin. A special apparatus is used.

Calcii Bisulphis. Is an antiseptic supplied in solution. Checks fermentation and putrefaction. Has been employed for preserving foods. ("Madame Rachel")

Calcium Sulphite, $\text{CaSO}_3 = 120.13$. A white powder, soluble in dilute Sulphurous Acid, has similar properties in less degree.

ACIDUM TARTARICUM.

Estimation of Lead in Tartaric Acid.

Best English tartaric acid as a rule does not contain more than 5 parts per million of lead and rarely exceeds 10. Foreign acids contain more. (*c.f.* Govt. Report *infra*).

Prepare a standard lead nitrate solution in water 0.4 Gm. in 250 Cc. This should be kept distinctly acid, and is diluted 100 times for use. 1 Cc. of this diluted solution contains 0.00001 Gm. Pb. 7 Gm. of tartaric acid are dissolved in 50 Cc. of water in a Nessler glass with internal diameter 2.5 Cm., and in another 2 Gm. of the same acid are dissolved in the same amount of water. To the first, ammonia is added in excess, and a few drops of a 10 per cent. potassium cyanide solution are added to prevent the iron and copper from interfering with the sodium sulphide solution which is then added to the first Nessler glass.

The amount of lead solution added to the 'dummy' to match the colour of the solution of the sample on adding sulphide is the amount present in 5 Gm. of the sample. One arrives, therefore, at the amount of lead present in parts per million; *e.g.*, 5 grammes of acid requiring 5 Cc. of diluted standard lead solution to balance coloration represent a content of 10 parts per million. Do not add lead solution after the sodium sulphide, this is a grave source of error.

To eliminate the inherent colour of the solution of the substance before adding the sulphide it may be necessary to add a minute quantity of burnt sugar to the 'dummy.'

If the sample be rich in lead, use correspondingly less of it, *e.g.* 2 Gm.
Method of Producing Lead-free Tartaric Acid.—Where the proportion of lead is excessive (*e.g.* 40 parts per million), pure lead-free acid for use as 'dummy' will be necessary. To prepare this 250 Gm. of the best acid obtainable are placed in a strong bottle fitted with rubber cork, and 1000 Cc. cold saturated hydrogen sulphide solution are added to nearly fill the bottle, which is (cautiously) then well shaken to dissolve the acid. Great internal pressure is produced owing to comparatively slight solubility of hydrogen sulphide in solutions of citric or tartaric acid. Allow to stand one day, filter, evaporate and crystallise. The solution on concentrating may become straw-coloured, which can be removed by stirring into the hot solution a crystal of sodium chlorate. The first crop of crystals equal to half the acid taken will be absolutely lead-free. C. Alex. Hill, C.D. March 15, 1905.

The Government Laboratories (MacFadden's Report to Local Government Board) found no Arsenic in the English Tartaric Acid and in no case more than 0.002% of lead—approximately ¼ grain per lb. With nearly half the foreign acids this figure was exceeded—the worst being a German acid and containing 0.0062% of Metall. Lead.

Minute amounts of Lead and Arsenious Oxide below 0.002 (= ¼ grain per lb.), and 0.00014% (1/100 grain per lb.) respectively, would not justify condemnation.—B.M.J. ii./07, 1140, c.f. also Arsenium Chapter.

Lead should not exceed 10 to 20 parts per million.

Off. requires not exceeding the latter figure and 1.4 per million Arsenic.

C. Alex. Hill communicated results of 4 years' testing of this and other chemicals for Lead and Arsenic.—C.D., ii./14, 17.

Acidum Glutaricum. *Syn.* *n*-PYROTARTARIC ACID.

$\text{COOH}(\text{CH}_2)_3\text{COOH} = 132.089$.

Isomeric with Methyl-Succinic, Ethyl-Malonic and Dimethyl-Malonic Acids, four isomers being possible. Colourless crystals,—soluble in water and alcohol. M.Pt. 97° C.

Experimentation by injection of dogs rendered diabetic by means of phloridzin,—showed its value in diabetes. The excretion of Nitrogen diminished. Seems to act by preventing the splitting up of the tissues, or food into sugar and urea.—B.M.J. ii./07,542.

[P1] ACONITI RADIX.

The B.P. does not give any support to British cultivation of plants. In the case of Aconite the cheap imported plants can be used and even if the alkaloids of foreign aconite consist chiefly of Aconine there is nothing to prevent its use, as the Off. work requires only a certain percentage of alkaloids without defining.—E. M. Holmes, P.J. i./15,5.

Off. requires not less than 0.4% Ether-soluble Alkaloids in the dried root.

Assay of aconite herb, root and extract by various methods using Iodeosin* as indicator; also method of examining this compound for analytical purposes.—P.J. i./03,267.

Assay experiments using the drug purposely spoilt by damp and allowed to go fungoid. Also results with old samples of the drug showed that the alkaloidal content is a distinct indication of the value corresponding with physiological test results. In the first case, *e.g.*, the alkaloidal content was 0.66% before and 0.3% approx. after spoiling. Aconite properly kept will not deteriorate. When deterioration is due to heat the weight of Ether-soluble residue is increased, the basic properties decreased, hence the deterioration is easily detected by volumetric assay. Chloroform should not be used in the assay.—P.J. ii./11,33.

A foreign sample of root, probably containing some *A. Variegatum* had 0.53% of alkaloid—practically pure Aconitine (Freund's formula). 1 Cc N/10 Acid (Cochineal)=0.06406 Gm.—Evans Anal Notes, 1912.

Farr and Wright found in Aconite Extract an average of 0.43% total alkaloid. The amount in the root is about twice that of the leaf. They found in dry root extract from 1.2 to 6%, English root being the best. A method of making the extract is outlined. The average yield of the dry extract was 25.9%, the Ether-soluble alkaloid in this averaging 1.95%. Foreign root yielded 30% with an average of only 0.68% Ether-soluble alkaloid. A standard of 1% proposed. The dose of this Extract would be $\frac{1}{2}$ to $\frac{1}{4}$ grain. Foreign root is very mixed owing to mode of collection.—P.J. i./13,216; C.D i./13,271.

Aconite Tincture and Liniment Assay.—Loss of time caused by filtering the acid liquid can be got over thus:—

Evaporate 15 Cc. of Liniment or 100 Cc. of Tincture at low temperature to remove bulk of the alcohol. Add 5 Cc. of 10% Sulphuric Acid. Shake with 20 Cc. Petroleum Ether, rinse same with water and extract with Ether after making alkaline. Evaporate the Ether extracts and titrate.—E. J. Chappel & N. L. Allport, B.P. Conf., 1920.

U.S. IX.—The fluid extract should kill guinea pigs in 12 hours in dose of 0.00004 Cc. per Gm. body weight. In the case of the Tincture U.S., 0.0004 Cc. and Extract 0.00001 Gm. per Gm. of body weight.—See U.S. IX., p. 606.

Ammonium salts can be decomposed by alkaloids (*e.g.*, Atropine, Aconitine and Strychnine) in favourable circumstances—may produce error in titrating residues. The power of expelling ammonia in this way is possessed probably by all alkaloids.—P. A. W. Self, P.J. i./15,585.

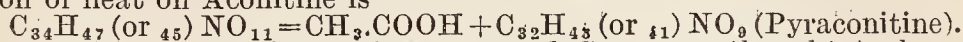
[P1] ACONITINA.

The B.P. 1898 formula was Dunstan's original one. The Off. formula is Schulze's—v.p. 17. Freund's formula is $C_{34}H_{47}NO_{11}$. (Schmidt at Marburg now also gives Freund's formula as the most likely). Dunstan also uses it for Aconitine prepared on the Continent, and suggests that the substance from English roots is a different body. Schulze says they are identical.

* NOTE.—Iodeosin Test Solution, *Syn.* Tetra-iodofluorescein $C_{20}H_8I_4O$, 0.1% in alcohol. Becomes colourless in acid solutions, pink in alkaline. Dilute the solution to be titrated with 100 Cc. or so of water, add 20 Cc. ether and 5 drops of the indicator and shake. Titration complete when pink persistent. For alkaloidal residues dissolve in known volume standard acid, dilute 100 Cc., and proceed as above. It is very suitable for use as an indicator when titrating alkaloidal residues with Centinormal or weaker acid

FR. CX. has also U.S. (Freund's) formula. Also PH. ITAL. Latter gives tests for pseudaconitine and aconine as adulterants.

Schulze and Liebner (Arch. d. Pharm., 1913, 251, p. 453) show that the action of heat on Aconitine is



Pyraconitine, according to Dunstan and Carr, was thought to have the composition $C_{31}H_{41}NO_{10}$. S. and L.'s examinations of the Salts of Pyraconitine (perchlorate, etc.), also confirm the above composition, and hence the new formula $C_{34}H_{47}NO_{11}$ or $C_{34}H_{45}NO_{11}$ for Aconitine. Pyraconitine is optically active, not inactive as stated by Dunstan.

Further work on Japaconitine (*c.f.*, Vol. I., p. 774), shows the pyrojapaconitine produced in analogous manner by heat is identical with pyraconitine, and that japaconitine and aconitine are probably isomeric.—C.D. ii./13,656; P.J. ii./13,541.

O. L. Brady, Jl. Chem. Soc., Oct., 1913, p. 1821, finds Freund's formula satisfactory, though combustion figures are equally in favour of Schulze's formula $C_{34}H_{45}O_{11}N$. The presence or absence of the 2H atoms will be determined when the constitutional formula is known. At present all that is certain is that it contains 4 Methoxy groups, 3 Hydroxyls, one Nitrogen-Methyl, one Acetyl and one Benzoyl group. The supposition that German Aconitine is not identical with English Aconitine cannot be founded on fact.—C.D. ii./13,706; P.J. i./14,219.

Oxidation of Aconitine.—In Aconitine there are 3 OH, 4 O.CH₃ and 1 CH₃ groups leaving a residue $C_{20}H_{21}N$. On heating Aconitine Permanganate with Dilute Sulphuric Acid a body termed **Oxonitin** is produced, neither basic nor alkaloidal nor acidic. It differs from Aconitine by $C_{10}H_{14}OH(OCH_3)$. From Oxonitin a hydrolytic alkaloid was obtained but insufficient for further investigation.

Japaconitine also yields Oxonitin by the same method.—P.J. ii./12,619. C.D. ii./12,752.

FR. CX. gives tests for distinguishing pure aconitine from decomposition products and substances which occur with it in the root.

Aconitine (like Hyoscine *q.v.*) is resistant to putrefaction.—*c.f.* P.J. ii./20, 222.

Pseudaconitine.—A crystalline alkaloid obtained from Indian (or Nepaul) aconite, *A. ferox*, melts at 201° C., and has the constitution of acetyl-veratryl-pseudaconine.

Indaconitine or Acetyl-benzoyl-pseudaconine—

Is from *Aconitum Chasmanthum*.

Bikhaconitine (crystalline) is obtained from *A. spicatum*.—L. ii./05, 1347. May be used as substitutes for aconitine and pseudaconitine for internal use, the dose in the case of the latter being $\frac{1}{2}$ of that of aconitine

ÆTHER.

Ether made from Methylated Spirit yields a proportion distilling below 34° due to the **Methyl Oxide** formed from the Methyl Alcohol. There is no objection to the Methyl Oxide when the Ether is used for local anaesthesia. The *Off.* test for Methyl compounds in Purified Ether says 'no violet colour in 20 minutes.' This is satisfactory if by violet colour a slight fuchsin tint is intended. This is confirmed by the fact that the addition of the least quantity of formaldehyde causes a marked violet. The purest Ether, however (even from Rectified Alcohol) gives a faint indigo blue in the time—this must not be confused.—D. B. Dott, C.D., Feb. 20/15.

A sample of ordinary 0.720 ether from S.V.M. gave nearly 24 parts of **Acetone** per 10,000.

As a qualitative test **Rothera's Nitro-Prusside Test** may be used. 5 Cc. of Ether, 1 Cc. of 5% Sodium Nitro-Prusside solution and 3 Cc. of Strong Ammonia are shaken together. Then solid Ammonium Chloride is added, *q.s.* to supersaturate and the whole shaken. Samples will show a slight reaction or none at all.—A. J. Jones, B.P. Conf., 1919.

Ordinary Methylated Ether in our experience gives coloration with this test.

Scott Wilson's Reagent.—Dissolve Mercuric Cyanide 0.5 Gm. and Sodium Hydroxide 9 Gm. in water 60 Cc., and add with constant stirring 20 Cc. of 0.727% Silver Nitrate solution. No turbidity should develop on shaking the ether with excess of the reagent.

For quantitative détermination employ Scott Wilson's method.—Jl. Physiol., XLII., p. 444.

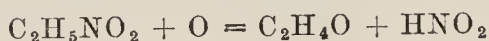
Anæsthesia in throat and nose operations. Ether is thought to be the proper anæsthetic—safer than chloroform.—Felix Rood, L. i./20,433.

ÆTHERIS NITROSI SPIRITUS. (*Off.*).

Estimation—5 Cc. of this Spirit treated with 5 Cc. of Potassium Iodide Solution and 5 Cc. of Dilute Sulphuric Acid yield at least 20 (B.P. '98 was 31½), but not more than 35 Cc. of Nitric Oxid corresponding to 1.52 to 2.66 % by weight of Ethyl Nitrite, Iodine being liberated.

Ammonium Acetate or Citrate hinders the deterioration of Spirit of Nitrous Ether.—D. J. Leech.

This preparation kept under the best conditions undoubtedly decomposes, aldehyde and acetic and nitrous acids being among the products of decomposition. There is, besides, a certain amount of loss by evaporation of ethyl nitrite. MacEwan in 1884 showed that under the best conditions the acidity of the spirit increases on keeping as well as the aldehyde. Decomposition of ethyl nitrite is inevitable, because the preparation contains about 10 per cent. of water, so that the ethylic ester and water interact, the preparation getting into a state of incipient decomposition, which is consummated as soon as the spirit is agitated with air, as is unavoidable in repeatedly opening the bottle. The first change may be the formation of aldehyde and nitrous acid, thus :



Then the aldehyde is oxidised into acetic acid.

In the course of time the nitrous constituent of the spirit entirely disappears, but aldehyde, one of the most readily oxidisable bodies, remains. It was also proved that formic acid is one of the products of decomposition of sweet spirit of nitre made from methylated spirit.

It is generally packed by the manufacturer in full bottles as soon as made, and its strength ascertained and recorded when bottled. It therefore reaches retailers practically of undiminished strength, and it is their duty to store the spirit in cool cupboards and in well-filled bottles, kept preferably upside down.—C.D. i./11,17.

With regard to the '*volatilisation*' of Ethyl Nitrite, Cowley finds that every trace of Ethyl Nitrite disappears from a solution within a few days in ordinary vessels. As to decomposition in an *Aqueous Solution*, a mixture containing Spirit of Nitre loses the whole of it in three days. With regard to decomposition in *Alcoholic Solution*, this is of such varied character that it is impossible to represent by an equation, though the following appears to be preliminary :



Solutions in Absolute Alcohol change less rapidly than those in 90% Alcohol on account of the Water present. A mixture of 90% Alcohol and Glycerin in equal volumes is a good solvent for all preparations of Ethyl Nitrite.—C. D., April 15/11,556.

ALCOHOL.

Alcohol Dilution Rules.

If **V** be the volume percentage of the stronger alcohol and **v** of the alcohol required—

I. *By volume.* Mix **v** volumes of the stronger alcohol with distilled water, *q.s.*, after cooling to make **V** volumes, *e.g.* to make an alcohol 43% from alcohol 95% take 43 volumes of the 95% and make up to 95 volumes.

II. *By weight.* Proceed on the same lines by weight throughout.

To Transpose Volume per cent. of Alcohol into Weight per

cent. The volume per cent. is multiplied by 0.7938, and the product divided by the Sp. Gr. of the liquid, *e.g.*, $\frac{80.22 \text{ V per cent.} \times 0.7938}{0.863} =$

73.7875 weight per cent. To express the **Weight per cent.** as **Volume per cent.** divide the weight per cent. by 0.7938 and multiply by the Sp. Gr. of the liquid, *e.g.*, 90.29 per cent. by weight = $\frac{90.29 \times 0.822}{0.7938} = 93.49 \text{ V per cent.}$

To state **Volume per cent.** as **Alcohol of Proof Strength.** Multiply V per cent. by 1.753 and deduct 100 from the product. Thus 65 V per cent. = $65 \times 1.753 - 100 = + 13.945^\circ$ over proof. Further, alcohol of 25 V per cent. = $25 \times 1.753 - 100 = - 56.175^\circ$ proof, *i.e.*, 56.175° under proof.

(B.P., 1885, stated: Proof spirit = about 57 per cent. alcohol by vol., *i.e.*, 57 parts alcohol with water produce 100 parts proof spirit.

\therefore 1 part alcohol will make $\frac{100}{57} = 1.753$ (about) parts proof strength.

Conversely to state **Alcohol of Proof Strength** as **Vol. per cent.** :—

Add 100 to the proof strength and divide the product by 1.753 ; thus,

$$13.945^\circ \text{ o.p.} = \frac{113.945}{1.753} = 65\% \text{ by vol., and}$$

$$56.175^\circ \text{ u.p.} = \frac{100 - 56.175}{1.753} = 25\% \text{ by vol.}$$

“**Proof Spirit**” has Sp. Gr. 0.920. This, in the olden time, was found to be the weakest spirit that could be put to the proof of igniting a little gunpowder moistened with it. If the spirit caught fire and inflamed the gunpowder, it was designated “over proof,” and if not, “under proof.” By the Hydrometer Act, 58 Geo. III. cap. 28, Proof Spirit is defined as spirit of strength, which at a temperature of 51° F. weighs exactly twelve-thirteenths of an equal quantity of distilled water.

Laws governing the Molecular combination of Alcohol with Water.—P.J. i./10,754.

The following Table, founded on B.P. 1898, and Gilpin's Tables shows :—

(i.) The volume of Distilled Water necessary to be added to 100 volumes of Alcohol (90%) for the production of each strength of Diluted Alcohol.

(ii.) The volumes of Alcohol (90%), and of Distilled Water respectively which, when mixed and reduced to 60° F. (15.5° C.), will produce, allowing for contraction in volume, 1,000 Cc., 1 pint, or 1 gallon of each strength of Diluted Alcohol.

The Specific Gravity and the exact Excise (Sikes') strength at 60° F. (15.5° C.), in degrees over proof (O.P.) and under proof (U.P.) of each dilution, are given in the first column.

TABLE FOR THE DILUTION OF ALCOHOL (90%) TO WEAKER (*Off.*), STRENGTHS.

Volume Percentage, Specific Gravity, and Excise Strength.	Alcohol. (90 per cent.)	Distilled Water.	Volume Produced.
70 per cent. Sp. Gr. 0·8900 22·7° O.P.†	100 vols. + 31·05 vols. 777·8 Cc. + 241·6 Cc. *648·5 Gm. + 241·6 Gm. 15 oz. 266 m. + 4 oz. 398 m. 124 oz. 215 m. + 38 oz. 307 m. *6 lbs. 7½ oz. + 2 lbs. 6½ oz.	= 128·57 = 10 0 Cc. = 1000 Cc. = 1 pint = 1 gal. = 8 lbs. 14½ oz.	
60 per cent. Sp. Gr. 0·9135 5·20° O.P.†	100 vols. + 53·65 vols. 666·7 Cc. + 357·8 Cc. *555·9 Gm. + 357·8 Gm. 13 oz. 160 m. + 7 oz. 74 m. 106 oz. 320 m. + 57 oz. 112 m. *5 lbs. 9 oz. + 3 lbs. 9½ oz.	= 150 = 1000 Cc. = 1000 Cc. = 1 pint = 1 gal. = 9 lbs. 2¼ oz.	
45 per cent. Sp. Gr. 0·9436 21·2° U.P.†	100 vols. + 105·34 vols. 500 Cc. + 526·6 Cc. *417·2 Gm. + 526·6 Gm. 10 oz. + 10 oz. 256 m. 80 oz. + 84 oz. 130 m. *4 lbs. 2½ oz. + 5 lbs. 4¼ oz.	= 200 = 1000 Cc. = 1000 Cc. = 1 pint = 1 gal. = 9 lbs. 7 oz.	
20 per cent. Sp. Gr. 0·9760 64·9° U.P.†	100 vols. + 355·8 vols. 222·2 Cc. + 790·7 Cc. *185·2 Gm. + 791 Gm. 4 oz. 213 m. + 15 oz. 390 m. 35 oz. 267 m. + 126 oz. 243 m. *1 lb. 13¾ oz. + 7 lbs. 14½ oz.	= 450 = 1000 Cc. = 1000 Cc. = 1 pint = 1 gal. = 9 lbs. 12¼ oz.	

NOTE.—*These figures are the WEIGHTS necessary to produce a gallon and a litre respectively, at 15·5° C.—P.J. i./98,501. † Stevenson

Detection of Methyl Alcohol.—Place in a 100 Cc. Erlenmeyer flask, as a check, Sodium Salicylate 0·5 Gm. and pure Alcohol 1 Cc., and into a similar flask Sodium Salicylate 0·5 Gm. and 1 Cc. of the Spirit to be tested. To both flasks add twenty drops of Sulphuric Acid in four parts at an interval of one minute. If Methyl Alcohol is present, an odour of Methyl Salicylate is developed.

Our experiments show (July, 1920) that a distinct odour of Methyl Salicylate is obtainable with a 1% admixture of Methyl Alcohol in S.V.R.

U.S. IX. test for Methyl Alcohol:—Dilute the spirit so that it contains about 10% by volume of Ethyl Alcohol. Place 5 Cc. of this dilution in a test tube, add 2 Cc. of 3% Potassium Permanganate Solution and 0·3 Cc. of Sulphuric Acid. Allow to stand 5 minutes. Add Sulphurous Acid Solution *q.s.* drop by drop with shaking to dissolve the Manganese Dioxide, then 1 Cc. of Sulphuric Acid and 5 Cc. of **Fuchsin-Sulphurous Acid Test Solution**. After standing 10 minutes the mixture should be colorless.

The **Fuchsin-Sulphurous Acid Test** solution is made thus:—To a solution of 0·5 Gm. Fuchsin and 9 Gm. Sodium Bisulphite in 500 Cc. of distilled water add 10 Cc. of Strong Hydrochloric Acid.

We have used this test—it is sensitive for small amounts of Methyl Alcohol. On the whole we prefer the Methyl Salicylate Test.

The original **Schiff's Reagent** for Aldehydes was ¼ this strength, namely 0·025% of Fuchsin decolorised with SO₂.

ETHYL ALCOHOL TABLE.

NOTE.—*Specific gravities are taken at 15.5° C.*

Sp.Gr.	Wt. per cent.	Vol. per cent.	Sp.Gr.	Wt. per cent.	Vol. per cent.	Sp.Gr.	Wt. per cent.	Vol. per cent.	Sp.Gr.	Wt. per cent.	Vol. per cent.
0.999	0.53	0.66	0.947	36.00	42.95	0.895	60.26	67.93	0.843	82.15	87.24
0.998	1.06	1.34	0.946	36.56	43.56	0.894	60.67	68.33	0.842	82.54	87.55
0.997	1.69	2.12	0.945	37.11	44.18	0.893	61.08	68.72	0.841	82.92	87.85
0.996	2.28	2.86	0.944	37.67	44.79	0.892	61.50	69.11	0.840	83.31	88.10
0.995	2.83	3.55	0.943	38.22	45.41	0.891	61.92	69.50	0.839	83.69	88.46
0.994	3.41	4.27	0.942	38.78	46.02	0.890	62.36	69.92	0.838	84.08	88.76
0.993	4.00	5.00	0.941	39.30	46.59	0.889	62.82	70.35	0.837	84.48	89.08
0.992	4.62	5.78	0.940	39.80	47.13	0.888	63.26	70.77	0.836	84.88	89.39
0.991	5.25	6.55	0.939	40.30	47.67	0.887	63.70	71.17	0.835	85.27	89.70
0.990	5.87	7.32	0.938	40.80	48.21	0.886	64.13	71.58	0.834	85.65	89.99
0.989	6.57	8.18	0.937	41.30	48.75	0.885	64.57	71.98	0.833	86.04	90.29
0.988	7.27	9.04	0.936	41.80	49.29	0.884	65.00	72.38	0.832	86.42	90.58
0.987	7.93	9.86	0.935	42.29	49.81	0.883	65.42	72.77	0.831	86.81	90.88
0.986	8.64	10.73	0.934	42.76	50.31	0.882	65.83	73.15	0.830	87.19	91.17
0.985	9.36	11.61	0.933	43.24	50.82	0.881	66.26	73.54	0.829	87.58	91.46
0.984	10.08	12.49	0.932	43.71	51.32	0.880	66.70	73.93	0.828	87.96	91.75
0.983	20.85	13.43	0.931	44.18	51.82	0.879	67.13	74.33	0.827	88.36	92.05
0.982	11.62	14.37	0.930	44.64	52.29	0.878	67.54	74.70	0.826	88.76	92.36
0.981	12.38	15.30	0.929	45.09	52.77	0.877	67.96	75.08	0.825	89.16	92.66
0.980	13.15	16.24	0.928	45.55	53.24	0.876	68.38	75.45	0.824	89.54	92.94
0.979	13.92	17.17	0.927	46.00	53.72	0.875	68.79	75.82	0.823	89.92	93.23
0.978	14.82	18.25	0.926	46.46	54.19	0.874	69.21	76.20	0.822	90.29	93.49
0.977	15.67	19.28	0.925	46.91	54.66	0.873	69.63	76.57	0.821	90.64	93.75
0.976	16.46	20.24	0.924	47.36	55.13	0.872	70.04	76.94	0.820	91.00	94.00
0.975	17.25	21.19	0.923	47.82	55.60	0.871	70.44	77.29	0.819	91.36	94.26
0.974	18.08	22.18	0.922	48.27	56.07	0.870	70.84	77.64	0.818	91.71	94.51
0.973	18.35	23.10	0.921	48.73	56.54	0.869	71.25	78.00	0.817	92.07	94.76
0.972	19.67	24.08	0.920	49.16	56.98	0.868	71.67	78.36	0.816	92.44	95.03
0.971	20.50	25.07	0.919	49.64	57.45	0.867	72.09	78.73	0.815	92.81	95.29
0.970	21.31	26.04	0.918	50.09	57.92	0.866	72.52	79.12	0.814	93.18	95.55
0.969	22.08	26.95	0.917	50.52	58.36	0.865	72.96	79.50	0.813	93.55	95.82
0.968	22.85	27.86	0.916	50.96	58.80	0.864	73.38	79.85	0.812	93.93	96.08
0.967	23.62	28.77	0.915	51.38	59.22	0.863	73.79	80.22	0.811	94.28	96.32
0.966	24.38	29.67	0.914	51.79	59.63	0.862	74.23	80.60	0.810	94.62	96.55
0.965	25.14	30.57	0.913	52.23	60.07	0.861	74.68	81.00	0.809	94.97	96.78
0.964	25.86	31.40	0.912	52.68	60.52	0.860	75.14	81.40	0.808	95.32	97.02
0.963	26.53	32.19	0.911	53.13	60.97	0.859	75.59	81.80	0.807	95.68	97.27
0.962	27.21	32.98	0.910	53.57	61.40	0.858	76.04	82.19	0.806	96.03	97.51
0.961	27.93	33.81	0.909	54.00	61.84	0.857	76.46	82.54	0.805	96.37	97.73
0.960	28.56	34.54	0.908	54.48	62.31	0.856	76.88	82.90	0.804	96.70	97.94
0.959	29.20	35.28	0.907	54.95	62.79	0.855	77.29	83.25	0.803	97.03	98.16
0.958	29.87	36.04	0.906	55.41	63.24	0.854	77.71	83.60	0.802	97.37	98.37
0.957	30.44	36.70	0.905	55.86	63.69	0.853	78.12	83.94	0.801	97.70	98.59
0.956	31.00	37.34	0.904	56.32	64.14	0.852	78.52	84.27	0.800	98.03	98.80
0.955	31.62	38.04	0.903	56.77	64.58	0.851	78.92	84.60	0.799	98.34	98.98
0.954	32.25	38.75	0.902	57.21	65.01	0.850	79.32	84.93	0.798	98.66	99.16
0.953	32.87	39.47	0.901	57.63	65.41	0.849	79.72	85.26	0.797	98.96	99.35
0.952	33.47	40.14	0.900	58.05	65.81	0.848	80.13	85.59	0.796	99.29	99.55
0.951	34.05	40.79	0.899	58.50	66.25	0.847	80.54	85.94	0.795	99.61	99.75
0.950	34.52	41.32	0.898	58.95	66.69	0.846	80.96	86.28	0.794	99.94	99.86
0.949	35.00	41.84	0.897	59.39	67.11	0.845	81.36	86.61	0.793	100.00	100.00
0.948	35.50	42.40	0.896	59.83	67.53	0.844	81.76	86.93	Based on figures of O. Hehner.		

The quality of Fuchsin used in the decolorised reagent may affect result. It is possible to detect readily 0.002 Ce. Methyl Alcohol in 5 Ce. of dilute (10%) Alcohol as taken for the test.—Evans.

Methyl Alcohol Poisoning.—Symptoms differ from those of ordinary spirit in the marked muscular weakness and defective cardiac action which are followed by nausea, vomiting, coma or delirium of a much more

intense and persistent character than those seen by ordinary intoxication.

Ethyl Alcohol undergoes complete combustion in the system while perhaps Methyl is oxidised to Formic Acid and possibly Formaldehyde—both more or less toxic.—L. i./20,130.

Drinking of Methylated Spirit. Suggested addition of $\frac{1}{2}$ grain Tartar Emetic per ounce and a poison label.—F. S. D. Hogg, L. i./20,788.

Methyl and Wood Alcohols and Acetone are markedly more toxic than Ethyl Alcohols. Deleterious effects of chronic alcoholism on growth.—T. Sollmann, O. H. Schettler and N. C. Wetzel, JI. Pharm. and Exp. Therap., Nov. 1920.

Aldehyde tests (P.G.V.) The red colour of a mixture of 10 Cc. of alcohol and 1 Cc. of potassium permanganate solution (1+999) should not turn to yellow within twenty minutes. On adding to a mixture of 10 Cc. of spirit, 10 Cc. of water, and 1 Cc. of silver nitrate solution (1+19), sufficient solution of ammonia to redissolve the precipitate at first thrown out, and then placing the mixture in the dark, no colouration or opalescence should occur within five minutes.

U.S. IX. requires that 10 Cc. with 5 Cc. of Liquor Potassæ (4.5%) does not at once produce a yellow colour.

AMOUNT OF ETHYLIC ALCOHOL BY VOLUME IN VARIOUS LIQUORS.

Whisky .. .. .	.. .. .	51—59%	White Wine .. .. .	.. .. .	12—14%
Rum .. .. .	.. .. .		Champagne .. .. .	.. .. .	10—13%
Gin .. .. .	.. .. .		Orange Wine .. .. .	.. .. .	10—12%
Strong Liqueurs .. .. .	.. .. .		Burgundy .. .. .	.. .. .	9—12%
Proof Spirit .. .. .	.. .. .	57%	Hock .. .. .	.. .. .	9—12%
Brandy .. .. .	.. .. .	43—57%	Claret .. .. .	.. .. .	8—12%
Port .. .. .	.. .. .	20—30%	Cider .. .. .	.. .. .	5—9%
White Wine (strong) .. .. .	.. .. .	23—29%	Strong Ale or Stout .. .. .	.. .. .	5—9%
Sherry .. .. .	.. .. .	16—22%	Beer and Porter .. .. .	.. .. .	2—5%
Madeira .. .. .	.. .. .	16—22%			

HALE WHITE.

The above are pre-war. Cf. Vol. I, p. 120 for controlled spirits.

Special Analytical Commission on Whisky and details of Manufacture.—The Hospital, Apl. 7,06, p. 8.

P. Helv. gives a useful summary of analysis of wines.

Alcoholic fermentation. Presence of Phosphorus (Phosphate) essential. (International Chemical Congress Paper) B.M.J. i./09,1375.

Suitable amounts of an Arsenate added to yeast juice increase rate of fermentation.—Na, Mar., 1911,65.

Beer—Materials and substitutes used in making.—B.M.J. i./09,673.

Alcohol without fermentation.—Some experimental attempts to de-alcoholise beer without altering its flavour, keeping qualities or aeration by the simple process of driving CO₂ into it, showed that it was possible to reduce the alcohol percentage to 0.2% at 120° F. On freezing and further treatment by the CO₂ the content rose to 1.16. Further experiments, however, not completely in accord.—P.J. i./11,30.

Royal Commission on Whisky and other Potable Spirits, Definitions of Brandy, Rum, Gin, etc.—B.M.J. ii./09,399.

Bonded Warehouses and Spirits in Bond.—C.D. ii./06,510.

Lancet report on Cognac brandy.—L. ii./03,1503

Alcohol consumption in 1913 had fallen from 32 gallons of beer in 1900 per head to 27 and from 1.22 gallons of proof spirit to 0.67.—Prof. Wild, L. ii./20,52.

Some 40 or 50 abstracts of Patents and references to the production of Alcohol from materials other than the usual maize, potatoes, molasses, e.g. bananas, apple juice, chicory roots, peat, straw, currants, oil cake, etc., were found in the J.S.C.I., between 1893 to 1911. A trial factory in U.S.A., is said to be producing 78 litres of Absolute Alcohol from one ton of dry sawdust (from one ton of potatoes 20 litres can be obtained). Sulphite Cellulose waste products said to be even more productive. The principle involved is the conversion of the cellulose into fermentable sugars.—Thomas Tyrer.—B. & C.D., May 26/11,452; L. ii./10,1924.

In the **Classen Process** for Alcohol production sawdust is digested with weak Sulphurous Acid in an autoclave under 90 to 100 lbs pressure, yielding a product containing 25% of sugar, 18% alkali or acid-soluble, and 56%

insoluble carbohydrates. The solid Saccharine residue is a suitable spirit making material, but the Spirits Act, 1880, places such restrictions on the Spirit industry as to stop the process.

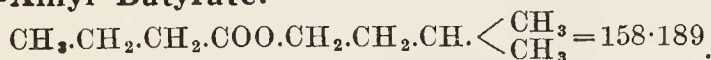
A factory capable of treating 200 tons of sawdust per week could turn out between 300,000 and 400,000 gals. of proof spirit per annum. This would also give by-products of 50 tons acetic acid, 10 tons furfural, and 2,000 gals. of methyl alcohol for recovery. The spirit produced is of high quality, being free from fusel oil.—A. Zimmermann, C.D., Dec. 7/12.

SYNTHETIC ALCOHOL by these stages : Calcium Carbide \rightsquigarrow Acetylene \rightsquigarrow Acetaldehyde \rightsquigarrow Alcohol. Possible commercial success in Switzerland, L. ii./17,250. From Ethylene extracted from Coal Gas, L. ii./19,340, and L. i./20,210.

For preservation of natural history specimens biologists might well make use of antiseptics instead of Alcohol and Methylated Spirit.—P.J. i./11,768.

Ethyl Butyrate.— $C_3H_7.COO.C_2H_5 = 116.126$. The chief constituent of Pine Apple Essence. A colourless liquid with Pine Apple odour Sp. Gr. 0.886 @ 15° C. Miscible with Alcohol. Boiling about 120° C.

Iso-Amyl Butyrate.



Colourless liquid with Sp. Gr. 0.882 @ 0° C. Used as a flavouring agent.

Commercially the article contains 78 to 93%. Sp. Gr. ranged from 0.853 to 0.860. R.I. 1.4073 to 1.4110 at 20° C. B.Pt. about 135° C.

ALDEHYDUM FORMICUM.

Formalin as Preservative.

By the **Linley Process** meat is sterilised by placing in "Chilling Rooms" and then to every cubic foot of space in the chamber at 50° to 60° F. a fan distributes 1 ounce of Formalin. This acts on the meat, which is finally frozen for shipment at 32° F.

The Local Government Board issued a report by Buchanan and Schryver on use of Formaldehyde and Paraform for meat preservation. Of the former a mixture of Glycerin, Salt and Formalin is used. Paraform is volatilised in shipholds to kill mould not stopped by the cold. Can be detected in the meat. Recommendation to limit use to sanitary disinfection before meat is introduced.—C.D. ii./09,343.

The process remains under careful observation and in present circumstances it does not seem necessary to take steps to prohibit its use.—L. i./10,833.

For Milk, etc., see Milk Analysis, pp. 452, 453.

Determination of Formaldehyde—4 to 4½ Gm. of the solution (if about 40%) is accurately weighed into a stoppered flask of 150 to 200 Cc. capacity. about 50 Gm. of Ammonium Chloride in fine powder are next added and then 25 Cc. of a double Normal Solution of Caustic Soda,—flask is shaken meanwhile. Contents and flask are allowed to cool down to temperature of room, then 50 Cc. of Water, containing 4 drops of 1% Solution of Methyl Orange are added and titrated with Normal Sulphuric Acid. The number of Cc. of Normal Soda used, multiplied by 0.06 gives the weight of Formaldehyde. If the solution be acid another portion is titrated with decinormal alkali and phenolphthalein and the necessary correction made in the amount of Soda neutralised.—P.J. i./11,433. Other methods P.J. ii./08,840 (Colorimetric) ii./10,637,881. Am.Jl.Ph., Oct. 1911, 455; c.f. also Estimation in Sapronaceous Solutions, *infra*.

U.S.IX. Method of Estimation is as follows:—

Transfer 3 mls of the solution of Formaldehyde to a tared flask containing 10 mls of distilled water. Stopper and weigh. Add 50 mls N/1 KOH., and then 50 mls. H₂O₂ solution (10 vol.) previously neutralised with KOH. Heat cautiously on the water bath 5 minutes, shaking cautiously. Allow to cool and titrate with N/1 H₂SO₄, using Litmus Solution. The U.S. solution shows not less than 37% HCOH, correction being made for acid if present. Each mil of N/1 KOH = 0.03002 Gm. H.CO.H. Each Gm. of the U.S. Solution corresponds to not less than 12.3 mls of N/1 KOH.

P. G. Method depends on reaction between Formaldehyde and Neutral Sodium Sulphite. The Bisulphite compound is formed and the Sodium Hydrate liberated is titrated with N/1 H_2SO_4 using Phenolphthalein as indicator :—



C. H. Hampshire and S. Furnival modified the P.G. process slightly as follows.—To 50 Cc. of freshly made Sodium Sulphite Solution (P.G. uses $12\frac{1}{2}$ Gm. of the crystalline salt in 50 Cc. of water), add a little Phenolphthalein, and make solution colourless by carefully adding N. Sulphuric Acid. 1 Cc. of the Formaldehyde is then added and the mixture titrated at once with N/1 H_2SO_4 until the colour completely disappears. 1 Cc. of Acid = 0.030016 Gm. HCOH.

They examined 11 samples of Formaldehyde Solution of commerce and found specific gravity to vary from 1.0804 to 1.0886.

H.CO.H by weight 35.38% to 37.33% ; average 36.56%.

CH_3OH by weight 10.16% to 14.97% ; average 13.68%.

Presence of Methyl Alcohol prevents polymerisation but renders the solution liable to duty on basis of Ethyl Alcohol.

Formaldehyde Tablets containing usually $\frac{1}{8}$ grain with Lactose, were found deficient. Estimation process by steam distillation.—P.J. ii./12, 133,174.

ALOES.

Extract Content in Aloes.

We obtained (1914) the following figures from 10 samples of Aloes—5 Socotrine and 5 Barbados.

Aloes Barbados	1.	2.	3.	4.	5.
Soluble in cold water. .	61.1%	62.0%	73.5%	69.6%	58.0%
Insoluble residue ..	30.0%	29.7%	16.6%	20.5%	31.5%
Aloes Socotrine	1.	2.	3.	4.	5.
Soluble . ..	49.2%	50.4%	51.0%	35.4%	49.2%
Insoluble	40.7%	40.4%	39.5%	53.8%	40.3%

The process was as follows—5 Gm. of Aloes in powder triturated with water 50 Cc. transferred to a counterbalanced filter paper and washed with sufficient water to make filtrate up to 200 Cc. An aliquot part (50 Cc.) was evaporated on the water bath and the residue dried for one hour at 110°C . the residue on the filter paper being pressed and dried at 110°C . for two hours. To obtain concordant results it is necessary to use the same volume of water. A figure for insoluble residue is not of much use alone as it does not give the soluble matter by difference owing to the amount of moisture present in the sample which is variable and accounts for the difference between the above figures and 100.

Off. requires loss on drying not more than 10%.

Tests for different varieties of Aloes, see Allen, 1913, Vol. VII., p. 146. Tests for Adulterants *ibid.* p. 138.

Anthraquinone derivatives other than Aloe-Emodin, Investigation to determine presence of. The results were negative. Aloe-Emodin was extracted by Petroleum Ether after distilling off an Essential Oil with steam. Both Cinnamic and *p*-Coumaric Acids were also obtained from the Aloes.—F. Tutin and W. J. S. Naunton, P.J. ii./13,836.

Characters and Tests of Aloin.

0.01 Gm. dissolved in 5 Cc. Water, 1 drop of Copper Sulphate Solution added and the mixture warmed, a red colour is produced—too much Copper spoils the colour.

The dry substance gives red colour with strong HNO_3 , but Aloin from Cape Aloes gives green. An aqueous solution shaken with Ether and the Ether layer separated and shaken with a little Caustic Potash, the latter becomes red—due to the small quantity of Oxymethylantraquinone present in Aloin.—P J. ii./10,235

AMMONIUM.

Spiritus Ammoniae Aromaticus.

Method of analysis and a suggestion for a change in the formula, ammonium bicarbonate recommended to take the place of the ammonium carbonate.—Am. Jl. Ph., Jan. 1912, p. 7. Composition of,—P.J. i./12,4.

Ammonii Sulphocyanidum. *Syn.* AMMONII RHODANIDUM.— NH_4CNS = 76.117. White crystals soluble in Water and Alcohol. Reagent in toxicology to separate Arsenic, Antimony, Mercury, etc.

Recovery after taking 30 Gm. of pure Ammonium Sulphocyanide in 200 Cc. of Water.—P.J. i./12,10.

Hydrazine. *Syn.* DIAMIDE $(\text{NH}_2)_2$ = 32.052. In the basic condition this body is not stable, but the Sulphate $(\text{NH}_2)_2\cdot\text{H}_2\text{SO}_4$ is a well defined stable salt,—white crystals soluble in hot water. It is a useful reducing agent, *e.g.*, in making Colloidal Metal Hydrosols. It has antiseptic properties, *e.g.* it will destroy fungi, etc.

Photographic use.—Caldwell discovered that the inclusion of the salts of Hydrazine, or Hydroxylamine, in the emulsion renders a plate practically proof against over exposure or reversal. *Plates or papers treated with the Hydrazine Salts may also be printed right out and toned like ordinary P.O.P., or partly printed and the operation completed by development, and in every case a photograph of extremely fine grain and with the most perfect gradation is obtained.*—C.D.

AMYGDALA AMARA.

OLEUM AMYGDALÆ ESSENTIALE.

In commerce in America Benzaldehyde is largely substituted for Oil of Bitter Almonds. Frequently Hydrocyanic Acid in sufficient quantity is added to meet the requirements of the trade or the U.S.P. Sp. Gr. should not be lower than 1.045 to 1.07 at 15°C ; *e.g.*, a sample gave gravity 1.075, containing 6.44% HCN. A pure oil requires 1 to 2 parts of 70% alcohol for solution. As to chlorinated compounds: It is becoming possible to produce Benzaldehyde showing absence of chlorine compounds. However, the presence of chlorine is strong indication of substitution. Value of copper and silver nitrate tests carefully discussed.—Am. Jl. Ph. Apl.'08,154.

U.S. IX. requires Sp. Gr. 1.038 to 1.06 at 25°C . In addition to the copper wire heating test for chlorine products, Nitrobenzene is tested for by adding 10 drops of the oil to a little alcohol, then adding zinc dust and 2 Cc. of acetic acid and boiling the mixture a short time. No odor of phenyl-isocyanide should develop after rendering strongly alkaline with Liquor Potassæ on addition of a few drops of Chloroform and heating. BENZALDEHYDE is assayed by means of Phenylhydrazine.

Oleum Amygdalæ Essentiale sine Acido Prussico.

Low refractive index (1.540) has been found latterly.—Evans.

AQUA LAUROCERASI.

It has been held that the method of preparation in the Fr. CX. is impracticable. The Fr. CX. assumes a content of 0.12 to 0.16% HCN in the leaves. They never yield 0.10%. The previous Fr. CX. formula was only $\frac{1}{2}$ this strength, *viz.*, 0.05%. According to N. Delabrière (J. Pharm. Chim. 1915), if the leaves are well crushed or disintegrated, not used entire or merely cut, the content of HCN in the water may be 1.5 to 1.7 per 1,000.

The bright green young *Prunus Laurocerasus* leaves were found to yield from two to four times the amount of Hydrocyanic Acid given by the older and more leathery brown leaves of cherry laurel. Adequate manuring caused increase in the amount of Hydrocyanic Acid contained.—D. H. Wester, P.J. i./14,643.

Test to distinguish Artificial Aqua Laurocerasi (made from Benzaldehyde, Hydrocyanic Acid and Water) from the genuine. Add a few drops of Congo Red solution to a few Cc. Bright red colour with the genuine, bluish or violet tint with artificial; Benzaldehyde owing to traces of Benzoic Acid acts on the Congo Red like an acid.—P J. ii./10,438.

AMYL ALCOHOL 'A.R.'

Tests.—10 Cc. should leave no residue on evaporation.

For Furfurol:—Not more than a pale yellow or reddish brown should be produced on shaking with equal volume of Sulphuric Acid.

Miscibility :—10 Cc. should mix completely with 10 Cc. of Hydrochloric Acid, Sp. Gr. 1.17; the addition of 1.5 Cc. of water should produce a permanent turbidity.

Oily Impurity :—2 Cc. with 10 Cc. of water and 10 Cc. of Sulphuric Acid should not show any oily layer after centrifugalising in a graduated Gerber milk tube several minutes.

AMYL NITRIS.

Tested by means of Allen's Nitrometer, a 5% solution in alcohol should yield not less than 7.9 times its volume of nitric oxide (Off.).

Our experiments show that this Standard is readily attainable, but it is important to observe that the yield of gas will vary from one experiment to another whilst using samples from the same (freshly made) Alcoholic Solution. This, we believe, is due to slight differences of working—the amount of shaking in the nitrometer, etc. Actual figures, for example, in one set of experiments (1914) were 7, 7.3, 7.6, 8, 8.2 and 8.5. As the errors cannot be in the negative direction, it is imperative to take highest readings when reporting upon a sample.

P. Jap. allows 0.6% acidity calculated as HNO_2 , i.e., 5 Cc. shaken with 0.1 Cc. of Ammonia Solution 10% and 1 Cc. water—the water must not be acid. Our examination of Amyl Nitrite by the test showed considerably less than this.

P.G. Test (for free Acid) is similar to P. Jap. It must not become turbid on cooling to 0°C . (absence of water).

P. Helv. and P.G. give test for Valerianic Aldehyde in.—1 Cc. warmed with 3 Cc. of a mixture of equal parts of Alcohol and Silver Nitrate and a few drops of Ammonia: must not blacken.

Amyl Nitrate. $\text{C}_5\text{H}_{11}\text{NO}_3 = 133.123$.

Colourless liquid, Sp. Gr. 0.999. Not used to any extent in medicine

Amyl Acetate. *Syn.* ISO—AMYL ACETATE, $\text{C}_5\text{H}_{11}.\text{CH}_3\text{COO} = 130.147$.

PEAR ESSENCE.—Made by action of glacial acetic acid on amylic alcohol in presence of a little sulphuric acid. Colourless Liquid. Miscible with alcohol and ether Sp. Gr. 0.876. B.Pt. about 138°C . Is used to dissolve resins in varnish making and in preparation of Collodions.

Commercial Amyl Acetate contains some of the other isomerides. At 3 isomers of Amyl Alcohol exist the acetate will vary considerably in different preparations. The iso-amyl form is generally present in dominant amount.—Thorpe's Dictionary and Allen, 1909, Vol. I., p. 249.

ANTIMONIUM.

Determination of Antimony in fæces, etc.—The specimen is extracted with hot dilute Hydrochloric Acid, the filtrate saturated with H_2S and heated, the ppt. is collected, washed and dried, evaporated with fuming HNO_3 and weighed as Sb_2O_4 .

A colorimetric method for minute quantities in food-stuffs, etc.—P.J. ii./10,417,630; i./11,621.

Antimony, Ores. In the assay of crude Antimony it was observed that the Antimony slightly exceeded in amount that required by formula Sb_2S_3 . Deficiency of Sulphur probably owing to presence of Oxide.—P.J. i./13,337.

Antimonii Chloridum, $\text{SbCl}_3 = 226.58$.

In colourless crystals. It is very corrosive and hygroscopic, hence **Butter of Antimony** used in veterinary practice is usually liquid; on addition to water, it decomposes into free hydrochloric acid and basic antimony oxychloride, powder of Algaroth; but is soluble in alcohol and carbon bisulphide.

Liquor Antimonii Chloridi. B.P. 1885.

A caustic liquid of reddish colour (due to iron as impurity) Sp. Gr. 1.47.

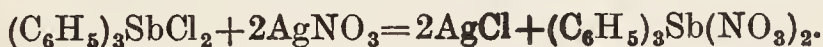
Antimonium Sulphuratum (Off.).

Estimation process. Oxidation with Sodium Peroxide, reduction and ultimate titration with Standard Iodine Solution. The antimony content should never be less than 30%.—P.J. ii./09,143

ORGANIC ANTIMONY COMPOUNDS.

G. T. Morgan, Micklethwait and Whitby communicated a paper on the Organic Antimony derivatives (see also recent treatise by Prof. Morgan, 'Organic Compounds of Arsenic and Antimony, Longmans, 1918)—**Tri-camphoryl Stibine Chloride** and **Tri-phenyl Stibine Hydroxy-nitrate** and **Hydroxy-sulphate**. Sodium Camphor and Antimony Trichloride in dry Toluene do not interact on lines analogous with the corresponding Arsenic reaction.

Triphenyl Stibine Chloride $(C_6H_5)_3SbCl_2$ (made by interaction of Chloro benzene, Antimony Trichloride and Sodium), treated with Alcoholic Silver Nitrate loses its Chlorine:—



The Triphenyl Stibine Nitrate formed undergoes however partial hydrolysis forming the Hydroxynitrate $(C_6H_5)_3Sb(OH).NO_3$. If Silver Sulphate be used instead of the Nitrate, the Hydroxysulphate $(C_6H_5)_3Sb(OH)SO_4.Sb(OH)(C_6H_5)_3$ is formed. It is less soluble in water than the Hydroxynitrate. It is suggested that one or other of these compounds may be suitable for use therapeutically. —J.C.S.T., Jan., 1910, p. 34.

Continuing the above work the authors report:—

Triphenyl-stibine Oxide has been obtained by hydrolysis of the Triphenyl-stibine Chloride (above), also a nitro-derivative of Triphenyl-stibine, melting at 190° , from this by reduction, a diazotisable *amine*. Some of the Acyl derivatives of this base have been prepared. By the nitration of Triphenylstibine Hydroxynitrate, a *trinitro*-compound is produced, which on reduction yields a crystallisable **triamine** furnishing a crystalline **Hydrochloride**. This base has also given **Acetyl** and **Azo- β -Naphthol** derivatives, together with **platinic**- and **stannic**-chlorides.

The sulphonation of Triphenylstibine and Triphenylstibine Hydroxy-Sulphate has been undertaken, and a soluble *Trisulphonic Acid* obtained, yielding very soluble alkali salts.—J.C.S.P., 1910, 151.

Prof. Morgan supplied us with the following compounds for trial, the results of which may be briefly recorded:—

(A) A complex **Antimonic Benzene-sulphonate** containing 22.3% Sb.

(B) A solution of **Sodium Triphenyl Stibine Oxide-trisulphonate** $O : Sb (C_6H_4SO_3Na)_3$.

(C) A further Antimony Aryl Sulphonate containing 7% Antimony, but more complex than (A) and occurring only sometimes as a by-product.

Experiments on Guinea-pigs.

The substance "A" was dissolved in water with the necessary amount of Soda, making a 5% solution. "B" and "C" were also used in 5% solution. Doses of $\frac{1}{2}$ Cc. of each ($=0.025$ Gm.) were tolerated. Two days later 1 Cc. of each ($=0.05$ Gm.) were injected into the respective animals with the result that after two days the dose of "A" killed the animal. In the case of the animal which had the dose of "B" and which was the heaviest of the three animals, the effect was very marked and the animal did not recover. "C" on the other hand was completely tolerated.

Taking the fact that 0.025 Gm. of each were tolerated—this means the equivalent of a dose of over 150 grains per 12 stone man, but generalisation on weight for weight basis is not justifiable.

It is known that sulphonates are in many cases almost too non-toxic. The substance "A" was found, however, to be inefficient against trypanosomes.

Triamino-triphenyl Stibine Oxide and compounds of same were active against trypanosomes, but preliminary trials of the Hydrochlorides *in vivo* suggest that they are irritant when introduced subcutaneously.

Prof. Morgan has also prepared a body giving analytical data corresponding with $\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{Sb}=\text{Sb}\cdot\text{C}_6\text{H}_4\cdot\text{NH}_2$. This body, it will be noted, has the Antimony in the molecule attached to the aromatic nuclei in the same manner as is seen in the case of the Arsenic in "Salvarsan."

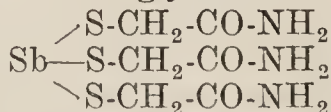
May.—Pr. Chem. Soc. 26 (1910) 142, J.C.S. 97, 1910, 1956, working also on Organic Antimony Compounds, gives a paper of which the following is a brief abstract:—Triphenyl Stibine Dihydroxide $(\text{C}_6\text{H}_5)_3\text{Sb}(\text{OH})_2$ is amphoteric in character. Experiments undertaken to observe the effect of the introduction of a NO_2 group on the relative stability of the various compounds such as R_3SbCl_2 , $\text{R}_3\text{Sb}(\text{OH})_2$, $\text{R}_3\text{Sb}(\text{NO}_3)_2$. Triphenyl Stibine Sulphate $(\text{C}_6\text{H}_5)_3\text{SbSO}_4$ was made. Permanganate and dilute H_2SO_4 oxidise Triphenyl Stibine to the Hydroxide $(\text{C}_6\text{H}_5)_3\text{Sb}(\text{OH})_2$. Alkaline Permanganate gives a better yield. The introduction of the NO_2 group into the Benzene nuclei of $\text{R}_3\text{Sb}(\text{OH})_2$ reduces the salt forming power of the molecule and lowers its stability as a whole.

The Antimony Analogue of Atoxyl is referred to.—Vol. I., p. 159 ; see also J.C.S.T., 1911, 1382.

Morgan and Micklethwait and also P. May have prepared *m*-Nitro-phenylstibinic Acid $\text{NO}_2\cdot\text{C}_6\text{H}_4\cdot\text{SbO}(\text{OH})_2$. On reduction this acid yields *m*-Aminophenyl-stibine Oxide $\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{SbO}$ and from this compound indications have been obtained of the production in small amount of *m*-aminophenyl-stibinic acid, the analogue of atoxyl, but containing its substituents in the meta-positions with respect to one another. Morgan and Micklethwait have also prepared di-*m*-nitro-diphenylstibinic acid $(\text{NO}_2\text{C}_6\text{H}_4)_2\text{SbO}\cdot\text{OH}$, a substance which on reduction yields di-*m*-aminodiphenyl-hydroxystibine $(\text{NH}_2\cdot\text{C}_6\text{H}_4)_2\text{Sb}\cdot\text{OH}$, and di-*m*-aminodiphenylstibine chloride hydrochloride $\text{Sb}\cdot\text{Cl}(\text{C}_6\text{H}_4\text{NH}_2)_2$, 2HCl . Both the base and hydrochloride have an irritating action on the mucous membrane of throat and nose which is even more intense than that of tri-*m*-amino-triphenylstibine and its salts.—*vide* J.C.S.T. 1911, 2294, J.C.S.P. 1912, pp. 5 and 19.

Sodium Antimony di-Thioglycollate $\text{Sb} \begin{cases} \text{S-CH}_2\cdot\text{COONa} \\ \text{S-CH}_2\text{ CO-O} \end{cases}$ and the

Triamide of Antimony Tri-Thioglycollic Acid



have been tried on experimental trypanosomiasis in rats, dogs and rabbits.—Jl. Pharmac., Baltimore, 2nd October, 1910, 101-144.

The results of the treatment appear to be as good as any hitherto recorded. P. May gives extracts of these papers.

The triamide is said to be well adapted for subcutaneous or intravenous use.

The injection of either of these two Antimony preparations at the time of the inoculation of the trypanosomes afforded complete protection. The Thioglycollate injected within the first 24 hours after inoculation also gave complete protection. A trial of these bodies in human trypanosomiasis is thought justified.—*v. also* M.A. 1911, 9.

Dosage and toxicity of Antimony compounds depend mainly on the presence of the trivalent Sb. atom, the pentavalent being less active. Organic Antimony bodies are found in both groups.—P.J. ii/12, 160.

For a recent paper on Organic Arsenic and Antimony Compounds by Prof. Morgan, see P.J. i./14, 537, 567.

For further Organic Antimony Compounds, see Vol. I.

ARGENTUM.

Argent Hair Dye (Black or Brown).

No. 1 Solution.—Silver Nitrate 1, Distilled Water to 12.

No. 2 Solution.—Sulphurated Potash 1, Distilled Water to 8. After washing and drying the hair, the solutions to be applied separately, in above order, and after 2 minutes the hair well washed with soft water. This dyes brownish black with one application, but lighter shades may be obtained by using a weaker strength of No. 1 solution, which should not be allowed to touch the skin.

Pyrogallol Hair Dye (Black).

No. 1 Solution.—Pyrogallic Acid 1, Alcohol (90%) 8, Distilled Water 40. Apply before No. 2.

No. 2 Solution.—Silver Nitrate 1, Strong Solution of Ammonia 1, Distilled Water to 8. Use as last.

This dyes grey hair *jet black* with one application.

Various other formulæ for “**Silver Hair Dyes**”—modifications of the above, *e.g.*, using a small addition of Sodium Meta-bisulphite in the No. 1 solution have been tried producing analogous result, but the difficulty about these preparations is that they simultaneously stain the *skin*.

Copper Pyro Hair Dyes (Odourless).

LIGHT BROWN.—Cupric Chloride ($\text{CuCl}_2 + 2\text{H}_2\text{O}$) and Pyrogallol of each 1 Water 100.

DARK BROWN.—Cupric Chloride 1, Ferric Chloride 0.5, Pyrogallol 1.5, Water 100.

BLACK.—Cupric Chloride 0.6, Ferric Chloride 2, Pyrogallol 2, Water 100. This produces a fairly natural tint.

Amidol Hair Dye (Black). Amidol 80 grains, Sodium Sulphite 120 grains, Alcohol 10%, 1 ounce.

A large number of experiments conducted, April, 1911, to determine the best *black dye that shall not stain the skin* showed that this Amidol formula stands first. With this dye the colour develops gradually, the excess of the solution dabbed on in the ordinary way can be slightly washed out, leaving the hair dark brown, but to produce a black, several successive applications may be necessary. In our experiments we find that grey hair so dyed will stand vigorous washing with soap and water without appreciably affecting the colour.

It will not stain the skin if carefully applied. It did not appear to rot the hair. The freer the hair is from grease—even the natural grease of the scalp—the quicker the action. A difficulty with regard to the solution is that it deposits the colouring on the side of the bottle.

The Amidol Dye is based on the formula in Pharm. Formulas, being double strength of the latter. The ordinary strength of Pharm. Form. gives a brown stain as stated. It has the advantage of being odorless and a *one* solution dye.

Next in order of merit in our opinion, came the "Argentio." It does not stain the skin if washed off soon after the dye has been employed.

ARSENICUM.

Detection of Arsenic in Drugs.—The Pharmacopœia Committee of the General Medical Council recommended the following method.

A solution of 4 Gm. of the drug is to be prepared as described in a series of special notes, and is to be diluted with water to a volume of 25 Cc. This solution is to be placed in a test tube of about three-quarters of an inch (about 2 Cm.) in diameter and 7 inches to 8 inches (18 to 20 Cm.) in length. Fragments of **granulated zinc** are to be put into the test tube until they reach to about two-thirds of the height of the liquid. Immediately after adding the zinc a small plug of cotton-wool is to be placed in the test tube above the liquid, and then a plug of **plumbised cotton-wool** so as to leave a short space between the two plugs, and a closely fitting cap formed of two mereurialised test papers to be fastened on; it must not be torn at all when fastened on the test tube. The test is to be allowed to continue for two hours at least, and the test paper is to be examined by daylight for a yellow stain. The test should be conducted in a place protected from strong light. It is applicable both in the case of arsenious and arsenic compounds.

Limit of Arsenical Contamination.—3 parts per million is an adequate limit for drugs given in small doses. It is equivalent to $\frac{1}{36}$ grain white arsenic per pound. $\frac{1}{160}$ grain of arsenious oxide per pound, *i.e.*, 1.08 of arsenium per million, is a reasonable limit for tartaric and citric acids, which are largely used in foods and drinks, *c.f.* also **Acidum Tartaricum**.

Bettendorf's Reagent for arsenic is a concentrated solution of stannous chloride in hydrochloric acid. A colourless arsenical solution will deposit brown metallic arsenic in the cold or on warming.

Gutzeit's Test. The substance to be examined is placed in a test tube with some arsenic-free zinc and sulphuric acid. The tube is plugged with cotton wool, and covered with filter paper having a spot of silver nitrate solution. A yellowish stain resulting in a few minutes indicates presence of arsenic. A control with lead acetate paper should be conducted to obviate confusion with sulphur.

A modification of the test consists in employing alkali instead of acid for generating the hydrogen and using a spot of mercuric chloride as in the customary test for arsenic in glycerin.

Modified Apparatus for Gutzeit's Test.—A four ounce wide mouth bottle is fitted with I.R. cork and a glass tube 200 mm. long and internal diameter 5 mm., open at both ends, the lower end drawn out with small hole about 1 Cm. from end at constriction. This arrangement allows condensed water to drip back into bottle while providing free upward passage for the gas. Roll of lead paper 10 Cm. long prepared with 10% solution of lead acetate and subsequently dried and pushed into tube so that upper end is 2 cm. from top of tube. Cap of mercuric chloride soaked filter paper (5.5 cm. in diam.) fits over top in ordinary manner. The hydrochloric acid used should contain a small percentage of stannous chloride to assist in gas evolution and to reduce arsenic to the "ous" state. Also to make results comparable with the standard, which is arsenious anhydride in hydrochloric solution, strength 1 Cc. = 0.00001 Gm. Stannous chloride is made by diluting the B.P. (1898) solution with equal volume of hydrochloric acid and boiling to eliminate arsenic completely. Filter and make up to original strength. One per cent. of this is added to the strong hydrochloric acid employed in the tests. Use 10 Cc. of the acid (containing 1% stannous chloride solution), 50 Cc. water and 10 Gm. zinc. $\frac{1}{500}$ th milligram of arsenium calculated as arsenious oxide gives distinct yellow stain, *i.e.*, one part in 5,000,000 can be detected and estimated. In the estimation of iron compounds distil the arsenious chloride after reducing to the "ous" condition. After dissolving, *i.e.*, in hydrochloric acid and potassium chlorate, add stannous chloride drop by drop to reduce completely, as seen by the yellow colour of the solution being discharged —C. A. Hill and J. C. Umney, C.D. ii./05,548; P.J. ii./04,500.

The modified Gutzeit Test is used in the B.P. with precise directions and a list of Limits of Arsenic in the substances to be tested is given in parts per million.

Method of employing arsenic-free ammonium chloride and magnesium powder produces a constant stream of arsenic-free hydrogen. The compound MgCl.OH is formed. Mercuric bromide is more sensitive than mercuric chloride.—P.J. i./o6,555.

Marsh's Test consists in generating hydrogen by means of pure acid and zinc, and to these is added the substance to be tested. If arsenic be present arseniuretted hydrogen is evolved, which deposits metallic arsenic in the cooler parts of the delivery tube, which is heated at several points by ^aid of Bunsen burners.

The deposit may also be allowed to form on a cool porcelain dish and is soluble in Chlorinated Lime Solution.

The addition of a little copper sulphate gave a mirror with only 0.0001 mgr. of arsenic, whereas platinic chloride (the customary addition to activate) only showed presence with 0.001 Mg.—P.J. ii./o6,325.

The **Sensitiveness of Zinc** is invariably increased by the use of **Cadmium Sulphate** and the use of this salt must be regarded as an essential and inseparable feature of the Marsh-Berzelius process.

To test Cadmium Sulphate for Arsenic, 10 Gm. should be distilled with Arsenic-free Hydrochloric Acid (20 to 30 % HCl .) and 0.05 Gm. of pure Ferrous Chloride. The distillate measuring 20 Cc. when introduced into the Marsh-Berzelius flask, should not give an arsenic mirror after 30 minutes.—'A. R.'—See Jl. S.C. I., 1902, 21, 94, Analyst, 1902, 27, 45, and 1907, 32, 247, and 1906, 31, 3.

Reinsch's Test consists in introducing copper to a hydrochloric solution. Cuprous chloride and hydrogen are formed. The latter reduces the arsenic to hydride; this reacts with the cuprous chloride, giving hydrochloric acid and depositing copper arsenide on the strip of metal employed.

§1 ORGANIC ARSENIC COMPOUNDS.

§1 **Sodii p-Aminophenylarsonas.** *Syn.* ARSAMIN (*c.f.* Vol. I.).

To test the purity of Sodium Arsanilate.

Apart from estimation of arsenic content *c.f.* Table p. 40 and determination of water of crystallisation, it may be mentioned that precipitation with Silver Nitrate is of little use to indicate arsenate as impurity. From our experiments it will not show more than 0.5% by color of the precipitate.

Sodium Arsanilate is reduced in the Marsh apparatus, yielding the usual black stain on porcelain.

To detect Arsenate as impurity in Sodium arsanilate we found it is best to dissolve 0.5 Gm. in 2 Cc. Hypophosphorus Acid, warming and diluting to 10 Cc. with water, then add 5 drops of Hydrochloric Acid, pass H_2S through the liquid, and warm slightly alternately. A bright orange yellow pp. will form rapidly if 0.1% Sodium Arsenate be present as impurity (W.H.M.). The Sodium Arsanilate in this method is not decomposed by the Sulphuretted Hydrogen.

§1 **Acidum Dimethyl-Amino-Phenyl-Arsenicum.** $(\text{CH}_3)_2\text{NC}_6\text{H}_4\text{AsO}(\text{OH})_2$. = 245.106.

Preparation—

Dimethyl-aniline 15 Gm. are mixed with arsenious chloride 25 Gm. and heated two hours on a water-bath, and poured into 300 to 400 Cc. cold water. The mixture dissolves in the water. Add sodium hydroxide in excess until the dimethyl-anilin-arsenious oxide at first thrown out re-dissolves (it turns milky at first). Shake out the dimethyl-aniline used in excess with petroleum ether and add hydrogen peroxide to the alkaline liquor. Dilute acetic acid throws out the body.

§1 **Sodii Dimethylaminophenylarsonas.** *Syn.* Sodium Dimethyl-Arsanilate. $(\text{CH}_3)_2\text{N.C}_6\text{H}_4.\text{AsO.OHONa}.5\text{H}_2\text{O}$ = 357.178.

Sodium dimethyl-arsanilate crystallises in leaflets, is soluble about 1 in 14 in cold water and slightly in alcohol, more so in hot and in dilute acetic and mineral acids,

[P] Acidum Di-Camphoryl-Arsenicum ($C_{10}H_{15}O$)₂AsO.OH = 410.308. Made by condensation of Arsenious Chloride with Sodium Camphor in dry Toluene, hardly soluble in water, readily in Benzene, Chloroform, etc. The alkali salts are, however, extremely soluble.

Arsenostibino and Arsenobismutho Compounds. Types AsR : SbR and AsR:BiR.—A number have been prepared, the former are stable, brown substances resembling the corresponding arseno-compounds, but the latter are very unstable. The arsenostibino-compounds exhibit marked medicinal power.—Ehrlich and Karrer (Ber., 1913, 46, 3564–3569) ex J.C.S.A. i./14,99.

ESTIMATION OF ARSENIC IN ORGANIC SUBSTANCES.

Several methods are provided in a paper by the author on "Organic Arsenic Compounds," Int. Cong., 1909. The following is simplest (arranged by the Author), and gives good results: Powder the substance carefully mixing with about equal quantity of potassium nitrate, moistening with water, then oxidise with nitric acid, taking up the dried material with acetic acid, adding sodium acetate solution, and titrating with Standard Uranium Acetate Solution 1 Cc. = 0.0053 gram arsenium. For example 0.464 gram Arsamin required 20.2 Cc. uranium solution = 0.10706 gram arsenium = 23.08 per cent. (theory with $4\frac{1}{2}H_2O$ = 23.4 per cent.).

P.G.V. gives the following for Sodium Arsanilate or the acetylated body:—0.2 Gm. is placed in a 100 Cc. Jena flask with a long neck, 10 Cc. of sulphuric acid and 1 Cc. of fuming nitric acid are added, and the mixture boiled for one hour. On cooling, 50 Cc. of water are added and then evaporated; this procedure is carried out twice. To the cold solution 10 Cc. of water are added and a solution of 2 Gm. of potassium iodide in 5 Cc. of water, and sufficient water to dissolve the precipitate. After standing for half an hour it is titrated (without using an indicator) with N/10 sodium thiosulphate. 1 Cc. of solution corresponds to 0.003748 Gm. As.

We have applied the first method to Arsenobenzol, and find it to work satisfactorily. (Oxidise carefully on the water-bath first.)

The process given by H. A. Ewins, namely, treating with potassium sulphate and sulphuric acid, with the addition of a little starch, heating until clear and almost colourless, then alkalisng with 50% Potash, cooling, re-acidifying, adding excess of Sodium Bicarbonate and titrating with N/20 Iodine (C.D. Nov. 25/16) we have also tried—the results being practically identical with those by the author's method.

To conduct the **Marsh Test** on Salvarsan oxidise with either Nitric Acid or with Potassium Chlorate and Hydrochloric Acid. The solution thus obtained is then reduced with Potassium Meta-bisulphite and dilute Sulphuric Acid and the excess of Sulphur Dioxide boiled off. This solution contains the arsenic in form of Arsenious Acid and is suitable for use. For further details on Toxicology see W. H. Willcox, B.M.J. i./16,474.

Arsenobenzol.

Purity of Solutions.

In preparing injections, all vessels employed should be sterilised by heating at 150° C. in a hot-air chamber or in steam. The saline solution must be above suspicion and germ-free. The mortar must be covered with a large funnel to prevent access of the bacteria falling in the room. The lip of each bottle used, whether it be water or sodium hydrate or saline, should be "burnt off" in bacteriological style. It is obvious, however, that the pharmacist has no guarantee either that the Arsenobenzol tube is free from air organisms or that Arsenobenzol has bactericidal action on air organisms. *The pharmacist cannot dispense a germ-free injection of a substance that will not stand boiling.* All that can be done is to take all possible and reasonable precautions to exclude excess of bacteria.

As to the water used, the French Military Medical Service are of opinion that sterilised water, even when not fresh, or boiled water, can be used impartially.—P. Ravaut, Arch. Med. et de Pharm. Militaire, Nov. 1916. c.f., also *Aqua Destillata, Bacteriological Examination*, p. 421.

Tests.—Animal Experiments.

Arsenobenzol is tested by the intravenous injection into a rabbit of a large dose only slightly less than that which may be expected according to Ehrlich's

publications to be lethal for the animal. A toxic oxide is liable to be present both in Arsenobenzol and Neo-Arsenobenzol.—Med. Res. Com., B.M.J. i./15, 694; L. i./15, 1102. See also W. H. Willcox, B.M.J., i./16, 474.

1 in 10 solution should be clear and be neutral to Congo Red paper, If 5 Cc. of Solution (1 in 10) be precipitated with 4 Cc. of Sodium Acetate Solution by warming for a short period on the water-bath and then filtered, the filtrate acidified with Hydrochloric Acid, should not be affected by H_2S . Another portion of the filtrate mixed with 3 Cc. of Ammonia and 3 Cc. of Magnesia Mixture should not deposit or become turbid after long standing.

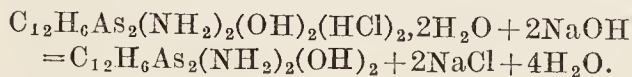
Ferric Chloride gives a deep blood-red colour not discharged by Concentrated Hydrochloric Acid. Bromine water gives a brown colour, becoming deep crimson in a few seconds. Further tests for identity v. P.J. ii./11, 383.

We found that a 1% solution in an amber bottle decomposed in about 48 hours giving a deposit which re-dissolved in acid or alkali but gave no reaction for inorganic Arsenic. The supernatant liquor turns dark. There was no apparent change in 24 hours in the same sample, but in white glass test tubes there were signs of decomposition in less than 24 hours.

Arsenobenzol Dihydrochloride is, contrary to prevalent views, stable in the atmosphere. The addition of alkali, however, leads to a rapid increase in the rate of oxidation. The Sodium compound is first oxidised to the corresponding oxide and this simultaneously to the pentavalent Arsenical. NOV-ARSENOBENZOL is rapidly oxidised in the air. The nature and rate of oxidation of Arsenobenzol and Novarsenobenzol to the oxides provide an explanation of the increase in toxicity and trypanocidal activity when these solutions are exposed to the air.—C. Voegtlin & H. W. Smith, J. Pharm. & Exp. Therap., Oct. 1920.

Chemistry of the Injections.

The reaction which takes place on bringing sodium hydrate sufficient to neutralise in contact with dioxy-diamino-arsenobenzol-hydrochloride may be indicated thus :



i.e. approximately :—

475·004 Gm. requires 2000 Cc. N/1 NaOH = 455·84 Cc. 15% w/w NaOH									
0·1	„	„	0·42	„	„	=	0·09	„	or $1\frac{1}{2}$
0·2	„	„	0·84	„	„	=	0·19	„	3
0·3	„	„	1·26	„	„	=	0·28	„	$4\frac{1}{2}$
0·4	„	„	1·68	„	„	=	0·38	„	6
0·5	„	„	2·10	„	„	=	0·48	„	8
0·6	„	„	2·53	„	„	=	0·57	„	9
0·7	„	„	2·95	„	„	=	0·67	„	11

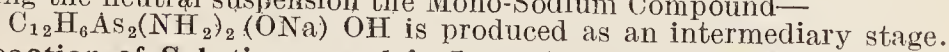
minims.

We see from the above that the **basic substance** is formed and is precipitated from solution.

This is the **Neutral 'Suspension'** as used in the *intramuscular injection*. Using *double* the amount of alkali in each case will produce the soluble Disodium Compound $C_{12}H_6As_2(NH_2)_2(ONa)_2$ as employed **intravenously**. Clearly before the basic body is produced, by the use of half the amount of Sodium Hydrate in the above formula the Monohydrochloride



By the use of $1\frac{1}{2}$ times the amount of Sodium Hydrate in the directions for making the neutral suspension the Mono-Sodium Compound—



Reaction of Solutions used in Injection and attendant pain.

We have always attributed some at least of the untoward results from the substance and the pain produced to faulty technique.

Undue acidity or alkalinity would naturally tend to produce pain and inflammation. Faintly acid injections are neutralised by the blood plasma which is met in the tissues.—C.f. notes under Intravenous Injection.

In our book 'Salvarsan' we give a critical survey of the reaction of all the various solutions advised by the early workers—some were markedly alkaline

Untoward Results—Arsenic Retention—Deaths.

Arsenic retention is likely to occur by the intragluteal method of injection hence the intravenous method has been more advised.

36 days after an intramuscular injection a very large proportion of the Arsenic may be still found in the muscles. Inflammation may hence occur.

Deaths.—A case of death after 0.5 Gm. reported. The case in question was the subject of much complication, bad nutrition and respiration, hypoplasia of the heart.—Münch. Med. Woch., No. 35 Aug. 30, 1910, p. 1822.

A death reported with 0.5 Gm. injected in the scapular region without any local reaction. Patient had had two apoplectic attacks. Poisonous symptoms developed in nervous system. Tremor, sweating, loss of strength—no symptoms in the digestive organs. Temperature rose to 39.8° C., and patient died on the fifth day with appearance of advanced heart paralysis. Post-mortem examination showed acute parenchymatous degeneration of the organs. Münch. Med. Woch., No. 42, Oct. 18, 1910, p. 2183.

Two cases of necrosis of the gluteal muscles after injection have been recorded. In one case death occurred ten days after the injection, in the other six weeks.

A death (a case of supposed cerebro-spinal syphilis) was hastened by a dose of the substance. Important to conduct a "Wassermann" before injecting with Salvarsan.—Salvarsan by M. and W., p. 44.

EHRLICH stated that the cases of death (about 12 in 12,000 cases), refer almost exclusively to cases of severe affections of the nervous system, tabes complicated with cystitis and cachexia, bulbar manifestation, patients with extensive epidermal softening and the like. Death may indeed be a matter of idiosyncrasy.

Death following. Three hours after intravenous injection vomiting, diarrhoea and sweats supervened, ultimately delirium, great cold, bowels unmoved, raging thirst, coma and death. Anuria said to be the cause. The author says dose must *always* be in *emulsion* and *intramuscular*, as thus it is more slowly absorbed.—B.M.J.E. i./11,71. Reported by E. L. Morata—Revista de Medicina y de cirugía Practicas, Feb. 28, 1911.

Death at German Hospital, London. Patient suffered from locomotor ataxy. Subcutaneous injection.—W. W. W. held inquest on this case.

Two deaths.—B.M.J.E. i./12,3.

Its use even in young and robust patients is by no means void of risk. Two American cases in which acute nephritis was produced by 0.6 Gm. intravenously in one case fatal anuria followed L. ii./11,1085. A robust man of 35 received 0.3 Gm. for a relapsing palmar and plantar syphilide intravenously. On the sixth day a further injection of 0.4 Gm. Congestion of the face, vomiting and epileptiform convulsions followed and died comatose.—L. ii./11,1286. A physician of 40 contracted a chancre on the septum nasi. Received two doses of 0.4 Gm., also as prophylactic a course of Mercurial tabloids. Death.—Details of the necropsy are given—reported by Prof. B. Fischer. A case of fatal jaundice following is also reported. An early case of general paralysis received 0.5 Gm. in Ireland with fatal result.—B.M.J. ii./11,1473, L. ii./11,1556. Most of the cases of death have followed a second injection. Prof. Fischer suggests that anaphylaxis may play a part. Ehrlich's (latest lecture.)—L. ii./11,1786.

Ehrlich on the proportion of deaths.—In view of the fact that more than 100,000 injections have been given, the proportion of accidents is comparatively small.—One of Ehrlich's recent lectures.—L. ii./11,1303.

"X" Rays and Arsenobenzol injections.—K. Ullmann and M. Haudek (Wien. Klein. Woch., No. 3, 1911) have shown by "X" rays that with the acid emulsion (Salvarsan as such in Oil or Liquid Paraffin?) the deposit of Arsenic persisted in the tissues almost without exception for a time which varied from several weeks to several months, the time being much longer than for the Mercurial preparations. The authors conclude that single injections of large doses are not to be recommended.—B.M.J.E. i./11,91.

Urine retention which lasted some days has been noticed; albuminuria also seen as an effect of the injection; disappearance of patellar reflexes; marked tenesmus and constipation. These symptoms thought to be very similar to those which accompanied Atoxyl.

The cessation of Arsenic output in the urine does not necessarily mean that there is no more Arsenic in the body; on the contrary, there may be a considerable deposit of Arsenic in the muscles which may lead to poisoning, especially if the dose be repeated.

Necrosis observed at the site of injection.—B.M.J. i./11,792.

The sloughs resulting on intramuscular injection on analysis, including those which formed three or four months after the injection, were found to contain large quantities of Arsenic, thus after a dose of 0.4 Gm. an amount of Arsenic = to 0.075 Gm. of Salvarsan was found in one slough four months later.—L. i./11,726.

The excretion period of the Arsenic is shorter after subcutaneous than after intramuscular injection. Simultaneous application of Mercury delays the excretion, whilst application of iodides shortens its duration.—B.M.J. ii./10, 1274.

Arsenic found in the urine 30 minutes after injection of 0.6 Gm. intravenously.—Stopford Taylor.—L. i./11,1413.

Ehrlich (Münch. Med. Woch., No. 1, 1911), also "Experimentelle Chemotherapie der Spirillosen" states that quite contrary to any evil results on the eye being expected, eye affections (iritis gummosa and optic neuritis) have been wonderfully treated.

A Bibliography of Deaths from Salvarsan concluding a paper by Sir Malcolm Morris.—L. ii./13,1243.

Two deaths from intravenous use.—Hirsch, B.M.J.E. i./13,24.

Histological changes in Salvarsan poisoning.—Why Salvarsan may be given with impunity so frequently and yet an ordinary dose prove fatal as in the case reported remains a problem.—L. ii./12,1234.

About 200 cases of deaths and of cases of blindness, deafness, encephalitis, paralysis, epileptiform convulsions and grave poisoning after Salvarsan have been recorded. It is stated that many cases are concealed.—Dr. Med. Drew, L. ii./13,1290.

Neosalvarsan given to mice in small doses was found to increase the vitality of tumours and to stimulate metastasis. Quinine Bisulphate, however, had a pronounced retarding effect. Opium extract had no influence one way or the other.—T. Mironescue, Comptes Rend, 1914, 158,893; P.J. i./14,772.

Salvarsan is sufficiently safe to be used for routine treatment of syphilis in the Army. Gibbard and Harrison, R.A.M.C., Jl., March, 1914, per M.P.C i./14,451.

Arsenical nephritis, Experimental in guinea pigs on giving Salvarsan, Atoxyl, Cacodylates, etc. The renal changes effected differ with the kind of arsenical body.—B.M.J. i./16,628.

Jaundice during treatment of syphilis with Arsenobenzol. Evidence is that the arsenical is conducive to its production. It is more common with Neo than with the original.—R. Hallam, L. i./20,1356.

Delayed Arsenical poisoning from Arsenobenzol preparations. A report of 58 cases during last 18 months—8 fatal.—G. S. Strathey and co-workers, L. i./20,802.

Critical Views.

Campbell Williams says many, if not all, of the reputed "cures" of parasymphilis reported in the early days of 606 were possibly errors of diagnosis and were really cases of pseudo or alcoholic mimicry. Evidence is accumulating of the failure of 606 and other organic Arsenic compounds to cure either G.P.I. or tabes, although temporary improvement has been noted after administration in veritable early cases. "Salvarsanized" Serum injections have disappointed expectations. The discovery of *spirochetes* within the cerebral nervous substance rather points to the non-existence of parasymphilis, or that it was solely DUE to the action of "antibodies" on the neurones—a better name would be "neuronic syphilis." It is well known that in such cases one may get a "negative" blood reaction, but a strong "positive" with the cerebro-spinal fluid.

Experience shows that the original claim of the Sponsors of Salvarsan namely, that a single injection of the preparation was curative, was a mistake. In certain cases it may clear up objective symptoms or lesions, anyhow temporarily. I have abandoned reliance on Salvarsan or its offspring Neo-Salvarsan as *curative agents per se*, and look on them as adjuncts in the treat-

ment of syphilis. Even the Arsenical apostles now advocate Mercurial medication subsequent to the Arylarsenates. It is claimed that one can cut short the period in which a syphilide can propagate the disease by using Salvarsan in lieu of Mercury. This most *dangerous dogma* is founded on the difficulty of finding the organism in the serum (blood) or lesions of the sufferer. Negative evidence is *dangerous* and not trustworthy. Having seen syphilis relapse in the form of mucous particles of the mouth after three intravenous injections of Salvarsan (and a month's treatment "*per os*" of Hyd. cum Creta gr. i. t.d.s.) I should refuse to give a patient a clean "bill of health" simply because spirochetes were not found and the blood gave a negative reaction, say *within* a month of leaving off Mercury. Mercurial treatment, if intensive or adequate, capsizes the Wassermann reaction. One gets a spurious negative when one really would get a positive if one left off Mercury and waited longer before testing the blood. The so-called pro-vocative treatment with 606 may give a *positive* reaction in patients who show no signs, past or present, of having been infected, who never were aware of having had venereal disease and who are *not* "congenitals." They have had a blood test made out of sheer curiosity or fear through attending lectures on syphilis. If further tests are made *when* the Arsenic has *ceased* to *act* on the tissue they are consecutively "negative." A logical deduction from this phenomenon is that 606 acts on the tissues of a non-syphilitic subject after the manner of the spirochetic toxin, producing some substance in the blood which gives a kindred positive reaction. The positive in a *non-syphilide* passes off quickly and negatives follow further tests. When the reaction is due to syphilis it persists unless Mercurial saturation is produced. No one should deny that Arsenic is valuable in the treatment of syphilis, particularly in the hospital class of patient. My experience is one of doubt upon the question of cure and re-infection. I am afraid that many of the so-called re-infections which are cited to prove "cures" are but relapses with local exhibition of the relapse after the manner of the recurrent induration of Ricord. Again, I have had a case which would have been recorded as a case of tabes either cured or arrested in progress if it had not been for the fact that the patient was not affected with Neuronic degeneration. He had one injection of Salvarsan. It was a mistake in diagnosis. I am still of the opinion, due to experience, that NO Arsenical preparation with which we are so far acquainted can be guaranteed either as an absolute cure or free from possible unexpected after effects. I have had a case of paralysis of both 6th nerves following two intramuscular injections of 0.6 Gm. Salvarsan. It may be contended that this was due to the disease and not to the drug. But in another case in which atrophy of the buttock and the whole of limb followed directly on an intramuscular injection, so that the patient appeared and walked as if he had had infantile paralysis, I had an object lesson and a warning. Moreover, in this case erection was marked by penile deflection to the affected side. I know of a case in which the patient died suddenly five days after an intravenous injection, given at his urgent request. The autopsy showed general fatty degeneration of the viscera, and was assumed by VERY competent people as being the direct result of the Arsenic. Arsenical Keratosis has been noted as an after effect of Salvarsan, and it remains to be seen whether Arsenical Cancer, which one used to see years ago, may not re-appear with its former frequency. It must not be taken that I am an opponent of the use of Arsenical preparations in the treatment of syphilis. They have their uses, limitations and drawbacks. But the advocacy of Mercury as complementary to a preliminary "Arylarsenization" seems, to my mind, to savour of a "chastened spirit," and a tacit admission that we have not yet found a "Royal road" to the cure of syphilis. Personally, I rely on perseverance and a judicious, intelligent, and adequate Mercurial treatment as my sheet-anchor—1914; and I still believe in the efficacy of Mercurial inunctions especially in syphilis of the nervous system. Inunction is tantamount to countless injections or molecules of the *base* into the lymphatics (the habitat of the spirochete) via the pores of the skin. I have found that I can get equally good results from 606—through suppositories of 0.1 gramme each—I order five. The first three are used at intervals of 4 days, the remaining two at intervals of a week or 10 days. The patient uses the 5 suppositories in from 26 to 36 days. They are used at bedtime after the rectum has been washed out by small enema. They are efficient, safe, cheap, and cause no inconvenience. I have *never* seen a case of syphilis

cured by 606 alone; though I have cured hundreds with nothing else but Mercury. They will stand any examination and any Wassermann test.—1920.

Major French communicates a lengthy article embodying many casualties and contra-indications with Salvarsan and concludes that it will never replace Mercury. He considers it unjustifiable to replace the judicious use of Mercury by it within the first six months from date of contagion in average cases of syphilis. His paper is intended as a defence of Mercury, not condemnation of Salvarsan.—L. i./11,1691; see also L. ii./11,1385.

Experiences at the Royal Infirmary, Edinburgh, in use of Salvarsan in conjunction with Mercury—the most potent and rapidly acting drug existent for the treatment of syphilis. No effect was produced on gonorrhœa. Venereal warts were not affected by the drug, neither was old standing leukoplakia of the tongue. Women exhibited less reaction than men. Patients expressed themselves as being remarkably improved in health.—L. i./11,1279, 1280.

In an editorial note in referring to the hideous deformities, etc., produced, one reads 'it is conceivable that time will show that this rapidity of action (effected by Salvarsan) constitutes the sole justification for its use—the permanency of the cure cannot yet be proved.'—B.M.J. ii./11,692

Syphilis has become attenuated in virulence,—man has acquired increased resistance and accommodation. That micro-organisms, on the other hand, can acquire immunity to human antibodies is common knowledge. Experience with Salvarsan appears to show that the *Spirochæta Pallida* may acquire a certain power of resistance to Arsenic. Even large doses fail. Probably the organism has become habituated to the poison,—a sort of Arsenic eater.—J. O'Carroll, Dublin JI. Med. Sci., Dec. 1912.

Salvarsan has lulled sufferers into a state of fictitious safety. Now that it has become a "cure all" there is less reason why faith should be placed in it for treating syphilis. Many relapses seen with it. No cogent reason for abandoning Mercury.—B.M.J. i./13,424.

Distilled Water *v.* Salvarsan. Large quantities of water are beneficial in syphilis.—C. F. Marshall, B.M.J. i./13,794. *c.f. Aqua Destillata.*

According to McDonagh Ehrlich's chemotherapy is not only the acme of speculation, but illogical from start to finish.—L. ii./16,121.

Estimation of the Arsenic excreted in the urine has been conducted, the general *Conclusions* being (a) the elimination begins rapidly; (b) the duration of the passing of Arsenic in the urine is longer than was thought; (c) after *subcutaneous* injection the elimination is concluded more rapidly than in the intramuscular method; (d) simultaneous use of Mercury caused delay in eliminating the Arsenic; (e) Potassium Iodide given at same time shortens the duration of the Arsenic elimination.

It appears the excretion is much slower with Salvarsan than with Atoxyl or Arsacatin when injected subcutaneously; also that whilst Atoxyl and Arsacatin are excreted quickly and almost completely by the urine in the case of "606" the Arsenic is largely to be found in the fæces.

After hypodermic, gastric or intramuscular use the elimination of Arsenic in the urine lasts about 25 days. The Arsenic, it is said, is largely changed into the ionic condition, and this may be related to its antisypilitic action.—J.C.S.A. ii./12,968.

Tests for Salvarsan: Recognition in Medico-Legal Cases.

The behaviour of Salvarsan with the usual reagents for Arsenic has been investigated to find a method of distinguishing between it and inorganic arsenic in medico-legal cases.

Muscle from a patient who had died three weeks after injections of Salvarsan still gave reactions for Arsenic. The drug gives the Reinsch, Marsh, Gutzeit (after oxidising and reducing) and biological tests for Arsenic. The following serve to distinguish Salvarsan from inorganic forms of arsenic. With Bettendorff's reagent it gives an amorphous, yellow ppt. which dissolves on warming and reappears on cooling. H_2S gives no ppt. even after a solution of the drug has been boiled with HCl. The organic part of the Salvarsan molecule gives certain reactions, which may afford confirmatory evidence of the presence of the drug, thus:—the corresponding diazo-derivative gives a characteristic red to violet precipitate with α -naphthylamine, which may be isolated and examined for arsenic by Reinsch or Gutzeit test. Atoxyl behaves similarly, giving a red azo-dye, but the diazotised Salvarsan gives no colour with β -naphthylamine, whilst Atoxyl gives a vermilion-red azo-colouring matter with the β -amine.

Minced horseflesh sprayed with Salvarsan solution and kept for 14 days was extracted with Alcohol, slightly acidified with HCl. The residue so obtained gave positive results with the Reinsch, Gutzeit, and *a*-naphthylamine tests, but negative results with Bettendorf's reagent, and with hydrogen sulphide. So far it has proved impossible to obtain good results by applying to Salvarsan ordinary toxicological methods for the estimation of arsenic, the latter being obtained only to the extent of from 29 to 29.5% out of the 34% present.—J.C.S.A. ii./11,448. See also W. H. Willcox, B.M.J. i/16, 474.

Wassermann's Reaction, Effect on.

Results with regard to Wassermann's Test, subsequent to injection vary. One authority states four out of 27 primary cases were negative to the test after injection, whilst in the case of 23 paralytic cases giving + reaction, a comparatively small proportion gave negative subsequently. In a larger proportion there was reduction in extent of response to the test.

Neisser "was struck by the fact that only 10% of the cases treated showed a transition from a + to — Wassermann, while recurrences were also observed in some cases."

Another operator says 50 out of 52 cases lost their positive reaction to the test in fifty days. It is believed that the arsenical body has no action in the test. Experimentally it was found to neither hinder nor favour hæmolysis. It is well known to be otherwise in the case of Mercury.

In one case, Wassermann's test changed to negative in 40 hours.

Ehrlich states that a + reaction occurring after—subsequent to injection is analogous with recurrence without external symptoms, and hence is an indication to inject again. It will be of great value to conduct the reaction systematically from time to time on cases which have been treated with Salvarsan so as to ascertain whether an actual cure has been established.

The reaction, according to another, cannot give conclusive result with regard to success of the injection until after six or eight weeks.

Congenital syphilis tends to give + Wassermann throughout life and this is not altered, however much Mercury is given. *That* positive reaction should not be taken as indication that Salvarsan has no effect on the Wassermann's reaction in congenital syphilis. In *late acquired* syphilis on the other hand, Salvarsan may change the reaction.—McDonagh.—L. ii./10,1490.

If at the end of the third week after injection the patient does not give negative reaction, advisability of giving a second dose is to be considered.—L. i./11,14,16.

Vagaries of Wassermann's Reaction before and after treatment.—H. C. French.—L. ii./12,228.

Salvarsan as a Test for Syphilis.—There is evidence that a spirochæte infection that has been in abeyance can be roused into sufficient activity to cause the Wassermann reaction to become positive, where previously (before injection) it had been negative. This result will enable the injection to be used as a test to say whether or not patient is cured of syphilis.—D'Arcy Power, B.M.J. ii./12,1606.

Blood Examination.—Blood examinations show leucocytosis after injection in some cases. May be as high as 30,000. Usual count is about 17,000 (McDonagh). See also Pernicious Anæmia, *Vol. I.*, p. 194.

Examination for Spirochetes.—The spirochetes are stated to disappear from the blood in about 24 to 48 hours after injection, but it may take considerably longer, *e.g.*, up to 14 days.

An experimental comparison (using rabbits) between "606," Mercuric Iodide and Potassium Iodide as antisypilitics: Salvarsan was the most marked spirochæticide, Potassium Iodide found to be not a direct anti-sypilitic.—L. ii./11,940.

What happens to the Spirochetes.—Ehrlich has stated that Salvarsan kills the spirochetes and the dead spirochetes liberate a protein which stimulates the production of a syphilitic antibody, and that on the extent to which this is effected the cure of syphilis depends.

McDonagh says parasitotropic substances act partly by killing the parasite and partly by liberating the chemical substances contained in the bodies of the parasites which kill off the remainder. That Salvarsan acts in this way is shown by the fact that larger doses are required to heal an early case with a primary sore, than a late case with gummata. Again, the cure of infants from infected mothers by injection of the latter (no Arsenic passing by the milk) is also in support of this view.—B.M.J. ii./10,1261.

Another authority says that the spirochetes become broken up into bead-like bodies or pieces by the action of the chemical—this at any rate in vitro. The spirochetes can be found in teeming numbers in a chancre before the injection, whilst the day after the injection they will have disappeared.

A pharmacologist writes:—"The parasites in the case of Salvarsan and Sodium Arsanilate, are able to break up the molecule and so liberate the arsenic in ionic form—such ionic arsenic is very toxic to protozoa. Suggestion is made that an Organic Mercury Compound might also work well on bacteria on analogous lines.—P.J. ii./11,16.

Another opinion is that it is too premature to say whether the effect consists in destruction of the whole or part of the parasites or simply in suppression of their activity.—L. i./11,731.

Spirochetes are *actually destroyed*.—D'Arcy Power, B.M.J. ii./12,1606.

McDonagh reviews the rationale of the action of Salvarsan and Neo-Salvarsan and concludes that a union takes place between the drug and the parasite with destruction of the latter. What the nature of the union is and why death of the parasite should follow are not explained. The action of the Arsenic according to McDonagh is merely catalytic—it is somewhat analogous with that of complement in the Wassermann reaction.

He says that Ehrlich's statement that Salvarsan is parasito-tropic only and not organo-tropic cannot hold good. For a drug to be parasito-tropic it must be organo-tropic. Its organo-tropic properties are indeed more important as most of the organisms are killed *indirectly*. The Salvarsan molecule becomes attached to the lipid globulin molecules of the serum which by a process of adsorption kills the parasites.—L. i./16,236,297. See also J. N. d'Esterre, L. ii./20,555.

N.A.B. 0.45 Gm. mixed with 2 Cc. of 1% Mercuric Chloride intravenously better than N.A.B. alone.—R. Johnson, B.M.J. i./20,436.

Silver Salvarsan in syphilis used extensively in Germany. The effect is similar. Stated to be more soluble. Give intravenously.—B.M.J.E. i./20,54.

AURANTIUM.

Terpeneless Oil of Orange (*c.f.* also Essential Oils Table).

A note from Sicily says the process of manufacture is exactly similar to that for terpeneless Lemon Oil, *q.v.*, except that a larger quantity of Terpenes are distilled off—about 95%. No physical or chemical data are known for the finished product, as it is only very rarely distilled, and then it is not a great success. The odour of the Terpeneless Orange Oil does not pay for the distillation in many cases.—The Terpeneless Orange Oils on the market are usually "synthetic" products, *i.e.*, a mixture of which the chief odoriferous constituent is Methyl methylantranilate. The distillation in London and elsewhere is carried out more scientifically than in Southern Italy.

Neroli Oil (Artificial) is a mixture the chief body of which is the methyl ester of Anthranilic Acid.—P.J. ii./06,377—to this the fragrance of the natural oil is due.

For genuine Neroli Oil, see Vol. I.

Concerning all the varieties of the genus *Citrus* and uses of.—P.J. ii./06, 717. See also Allen, 4th Edn., Vol. IV., p. 359.

Petitgrain.—This name is given to the young orange fruits which fall naturally after "setting." Oil of Petitgrain is distilled from them.

Petitgrain Oil.—Adulteration with Terpinyl Acetate. Detection by taking saponification value at 1 and 2 hours.—P.R., 1912,3,240.

Paraguay produces Oil of Petitgrain.—P.R., Dec., 1913, p. 414.

Table of some Organic Arsenic Compounds showing Molecular Weights, Content of Arsenium (As), and Solubilities.

ARSENIC COMPOUND AND FORMULA.	Molecular Wts. employing Inter- national 1917 Atomic Wts.	Arsenium content per cent.	SOLUBILITIES.	
			Water.	Alcohol 90%
Acid. Cacodylic, $(\text{CH}_3)_2 \text{AsO.OH.}$..	138.026	54.3	2 in 1	1 in 4
Cacodyle, $(\text{CH}_3)_2 \text{As} - \text{As}(\text{CH}_3)_2.$..	210.036	71.4		
Cacodyle Oxide $(\text{CH}_3)_4 \text{As}_2\text{O.}$..	226.036	66.3		
Calcium Cacodylate $[(\text{CH}_3)_2 \text{AsO}_2]_2 \text{Ca}$..	314.106	47.7	2 in 1	1 in 2
Sodium Cacodylate $(\text{CH}_3)_2 \text{AsO.ONa} 3\text{H}_2\text{O}$..	214.066	35.0	2 in 1	About 1 in 1
Magnesium Cacodylate $[(\text{CH}_3)_2 \text{AsO}_2]_2 \text{Mg.}$	298.356	50.25	1 in 3	Insoluble
Iron Cacodylate $[(\text{CH}_3)_2 \text{AsO}_2]_3 \text{Fe}$..	466.894	48.17	1 in 15	Insoluble
Guaiacol Cacodylate, $(\text{CH}_3)_2 \text{AsO.OH.C}_6\text{H}_4.\text{OH}(\text{OCH}_3).$..	262.125	28.6	1 in 25	1 in 1.5
Strychnine Cacodylate $\text{C}_{21}\text{H}_{22}\text{N}_2\text{O}_2(\text{CH}_3)_2$ AsO.OH	472.327	15.8	hardly	1 in 80
Di-sodium Methylarsenate (Arrhenal) $\text{CH}_3\text{AsO.}(\text{ONa})_2 5\text{H}_2\text{O.}$	274.069	27.3	1 in 1	Slightly
<i>p</i> -Amino-phenyl-Arsonic Acid. $\text{NH}_2\text{C}_6\text{H}_4\text{AsO}(\text{OH})_2$ (Arsanilic Acid) ..	217.064	34.5	Slightly	Slightly
Sodium-<i>p</i>-amino-phenyl Arsonate $\text{NH}_2\text{C}_6\text{H}_4.\text{AsO.OH.ONa.} + 4\text{H}_2\text{O.}$..	311.120	24.09	1 in 6	1 in 125
Ditto Ditto Anhydrous.	239.056	31.4		
Mercury Atoxylate $(\text{NH}_2\text{C}_6\text{H}_4\text{AsO.OH.O})_2 \text{Hg.}$	632.712	23.7	Insoluble	
Dimethyl-amino-phenyl-arsonic Acid. $(\text{CH}_3)_2 \text{N.C}_6\text{H}_4\text{AsO.}(\text{OH})_2.$	245.106	30.6	Almost insoluble	Almost insoluble
Sodium Dimethyl-Amino-Phenyl Arsonate $(\text{CH}_3)_2 \text{N.C}_6\text{H}_4\text{AsO.OH.ONa.} 5\text{H}_2\text{O}$	357.178	21.0	1 in 14 (more in hot).	Slightly (more if hot).
Acid Di-camphoryl-arsinic. $(\text{C}_{10}\text{H}_{15}\text{O})_2 \text{AsO.OH.}$	410.308	18.3	Hardly 1 in 5	Easily 1 in 12
Dioxy-diamino-arsenobenzol Di- hydrochloride. (Arsenobenzol) $\text{C}_{12}\text{H}_{12}\text{O}_2\text{N}_2\text{As}_2(\text{HCl})_2 2\text{H}_2\text{O}$	475.064	31.56		
Novarsenobenzol				
$\text{C}_{13}\text{H}_{13}\text{O}_4\text{N}_2\text{SAs}_2\text{Na}$	466.169	32.1	Readily. Very soluble.	Very Slightly. Very soluble.
Sodium Benzo-sulpho- <i>p</i> -amino-phenyl Arsonate (Hectine) $\text{C}_6\text{H}_5.\text{SO}_2.\text{NH.C}_6\text{H}_4.\text{As.O.OH.ONa.}$..	379.178	19.77		Practi- cally insoluble
Tetra-oxy-Diphosphamino-Diarsenoben- zol (Galy) $\text{C}_{24}\text{H}_{22}\text{O}_8\text{N}_4\text{P}_2\text{As}_4.$	856.256	64.19	Readily	insoluble
Sulfarsenol appears to be chemically = Novarseno benzol.	466.169	32.1	Readily	Very slightly.
<i>Dose:</i> Intravenously, intramuscularly and subcutaneously 0.12 to 0.18 Gm. in $\frac{1}{2}$ to 1 Cc. water. Used in syphilis.—F. C. Doble, L.ii/20,243.				

BELLADONNA.

Although Belladonna and Hyoscyamus owe their activity chiefly to the same alkaloid Hyoscyamine, their preparations are by no means interchangeable. Part of the difference of action may be due to the fact that **Hyoscine** is present in larger proportion in Hyoscyamus than in Belladonna, thus accounting for greater sedative action.

Hyoscyamine if heated or allowed to remain in an alkaline condition is converted to Atropine and the physiological activity is thereby modified. Atropine acts only half as strongly as Hyoscyamine on the peripheral nervous system, but it has an activity equal with that of Hyoscyamine on the central nervous system. Hence care is necessary in making preparations. The formation of Atropine is minimised by concentrating in vacuo. Without this precaution there is indeed risk of decomposing the Hyoscyamine altogether, forming tropine and atropic acid.—C. A. Hill, Pres. Add., B.P. Conf., 1920.

Assay and Alkaloidal Content.

Farr and Wright found a minimum of 0.14 and a maximum of 1.32% (exceptional) total alkaloids in the leaves, an average of 0.547%—rather more than is generally found in the root.—P.J. i./05,398; C.D. i./05,425.

Roots of our own growing gave the following:—Second year's growth, 0.605%; fourth year's, 0.51%. Three years is believed to give about the best yield.

MacEwan and Forrester supplied figures indicating variability of the alkaloidal content—0.10 to 0.65%—the most frequent value being 0.451, and the mean 0.339%. Galenical preparations of Belladonna differ in action from the alkaloids contained. Alkaloid determination does not suffice. Thoms, it may be recalled, found in two Belladonna Extracts (P.G. earlier edition) each containing 1.72% alkaloids, 3.5 and 8.1% Tannin, 1.8% of other organic bases (in each); Permanganate numbers 81 and 256; and 15.7 and 11.5% volatile matter,—showing that alkaloidal determination is not finality in evaluation. There is much divergence regarding pharmacopœial requirements, and analyses are necessary with the view of ascertaining if the drug is harvested at the proper season.

Cultivation of Belladonna in America.—Two crops of leaves are obtained—one at end of July and the second in October. If the roots are not required for use they should be taken up in October and buried in a shed to preserve from frost, to be divided into five or six rootlets in the spring for propagation. This procedure is better than growing from seed. An acre yields six to eight thousand pounds of herb.—Am. Jl. Ph., 1909,811; P.J. i./09,150.

The highest alkaloidal content was obtained from a plot which had not been manured at all, but which was **fully exposed to the sun**. This content (1.035% in the dry leaf) from leaf collected September, 1911, was the highest ever recorded as having been obtained. The content from leaves under similar conditions, September, 1910, was 0.44%, June, 1911, 0.65%,—each the highest as against plants grown with artificial manures and far in excess of the yields from plants grown *in the shade*.—F. Ransom and H. J. Henderson, Int. Cong. Applied Chemistry, 1912. This is of especial interest more particularly as Belladonna and Digitalis are frequently found in nature in partially shaded situations. Indeed, it has been advised to grow Belladonna in the shade. The results also are exactly analogous with the author's cultivation of Digitalis. He has found (*c.f.*, "Digitalis Assay") that plants grown in the sun were the most active both by chemical and physiological assay.

Belladonna leaves grown in the shade contained 0.35% total alkaloids,—that grown in the sun 0.4%.—W. Unger, Y.B.P., 1913,261.

Artificial Manures, *e.g.*, Sodium Nitrate 1 cwt., with Kainit 3 cwt. per acre, increase the yield of *green plant* per acre. This yielded 13½ tons per acre September, 1911, as against the plot with no manure, but sun, 8½ tons per acre.—Ransom and Henderson, *ibid*.

Basic Slag 2 cwt. per acre and Superphosphate (5 cwt.) applied March to April had good effect on alkaloid yield.—better than farmyard manure. The highest percentage of alkaloids has been observed in sunny seasons. Cultivated plants yielded as much as 1.08% alkaloid.—F. H. Carr, Int. Congress App. Chem., C.D. 1912, p. 432; Y.B.P. 1913.

Experiments by A. F. Sievers at the Office of Drug Plant Investigation, Washington, on *Atropa Belladonna* (first, second and third year's growths) showed that the alkaloidal content of the leaves of first year's plants (1910) gave an average of 0.547%, the highest being 0.7% and the lowest 0.334%; the same plants yielding approximately the same amount of alkaloid from season to season. The leaves can be picked to best advantage from the time of flowering until the early berries begin to ripen. Later the leaves are richer, but are too small and sparse for harvesting.—C.D. i./14,52.

Indian Government Belladonna grown at a high elevation (6,500 ft.) in rich virgin soil contains high percentage of alkaloid.—E. M. Holmes, P.J. ii./18, 103; i./19,2. Evans found in the leaf 0.41% alkaloid and in the root 0.4%.

Cultivation in Kumaun (North West Provinces). Ten tons of fresh leaves picked during the year ending March 21/20.—Norman Gill, C.D., 1920, p. 1400.

Epitrix Atropæ Foudras. A small beetle has made its appearance in *Belladonna* plants at Hitchin, especially prevalent in dry seasons. Recommendations are given for cultivation which would tend to eradicate the insect.—Perrédes, P.J. ii./10,135.

Belladonna Fruit, either ripe or unripe, contains 0.1 to 0.13% Alkaloids.—P.J. ii./09,473.

Frogs' and rabbits' livers have the power of destroying Atropine. This is due to a soluble body resembling a ferment. None of the tissues investigated in the cat, rat and dog have any like power.—B.M.J. ii./12,1099.

Elimination of a *Belladonna* preparation taken internally is rapid. It rarely produces poisonous effects.—L. ii./10,575.

Extractum Belladonnæ Viride (B.P. 1898).

Microscopical identification of constituents.—P.J. ii./08,834.

Extracts prepared from the dried drugs have replaced the green extracts in the Continental Pharmacopœias, agreeing with the F. I. requirements. Experiments using various parts of the plant, fresh leaf, subaerial stem, etc., and extracting by various methods showed that the fresh herb dried and percolated to exhaustion with 70% alcohol, the alcohol distilled off the precipitated resin and chlorophyll filtered off and the filtrate evaporated gave an extract with alkaloid content of 2.2%,—much higher than any of the others.—P.J. ii./11,35.

Evans finds as average in the extract 0.45 to 0.7% alkaloid.

Extractum Belladonnæ Foliorum (Alcoholicum).

The average yield was found by Farr and Wright to be 1%. The stronger the alcohol used the better the extraction—using 90% alcohol, 4% alkaloids were obtained against 2.15% only when employing 50% alcohol.

For POWDERED EXTRACT, powdered leaves recommended as diluent should be well dried first, and must contain sufficient alkaloid to permit of their being used in the proportion of 2 of diluent to 1 of extract. This keeps well.—P.J. i./05,398; C.D. i./05,425. The use of dried exhausted marc would greatly simplify.—H. Deane.

Regarding these notes, c.f., *Extractum Belladonnæ Siccum (Off.)*.

BISMUTHUM.

Liquor Bismuthi et Ammonii Citratis. (Off.).

We find it best to store in *full* moderate sized (stoppered) bottles, which contain sufficient for *immediate* use. Sterile materials and utensils should be used. The Liquor made and kept in this manner will keep good for years. The addition of 1 of chloroform in 400 parts is also useful. The solution of ammonia used must be quite free from tarry matter. Test for the latter by adding 2 to 3 Gm. of copper sulphate to the ammonia solution until it smells very slightly of ammonia; tar constituents will colour it.

Our experiments show that the *B.P. 1885 method is best*—is both economical and expeditious. It is important that the Bismuth Citrate should be pure.

In the *Off.* method more washing than that specified may be required. And if a large amount be used there appears liability to reform some subnitrate which will not dissolve in the Ammonia.

R. C. Cowley gives directions for preparing a neutral Ammonium Bismuth Citrate—a modified form of that published in P.J. and C.D. Dec. 23, 1899—Precipitated Bismuth Citrate in the freshly precipitated condition acts a

a monobasic acid which can be quantitatively estimated with Ammonia Solution,—using Litmus as indicator—in this way a neutral Liquor Bismuthi can be made. It forms a clear solution with Sodium Bicarbonate (Commercial Liquor containing free Ammonia converts Bicarbonate to Carbonate,—the latter then precipitates Bismuth as Carbonate).—C.D. i.11,314; Austral. J1, P. Jan., 1911.

This does not agree with practice. A considerable excess of Ammonia is always required to effect solution. Cowley's formula in "Pharmaceutical Formulas" contains $1\frac{1}{2}$ mol. Ammonia to one of Bismuth Citrate.

Careful experiments by us showed that 1 mol. weight of commercial Bismuth Citrate required approximately 2 molecules of Ammonia to dissolve to an alkaline solution. This Solution, on adding Citric Acid to neutralise $\frac{1}{2}$ a molecular weight of the Ammonia, becomes amphoteric to litmus. Therefore, 1 molecule weight of Citrate to make a Neutral (amphoteric) Solution requires $1\frac{1}{2}$ molecular weights of Ammonia.

We found Sodium Bicarbonate to be compatible with this, and also with an alkaline stock liquor in the proportion of 4 grains to the drachm without causing precipitate for over a month. Precipitation, however, had occurred in the neutral solution in 3 months.

BISMUTHI SALICYLAS.

Bismuth in organic compounds, Salicylate, Liquor, Xeroform, etc., is easily estimated by reducing to metallic Bismuth with Formaldehyde.—S. B. Tallantyre, B.P. Conf., 1919.

5 Gm. treated with 50 Cc. of dry ether should yield not more than 0.005 Gm. Salicylic Acid.—*Off.*

Rectified Benzol as extractive. If allowed to percolate through the sample and the liquid be dropped into dilute Ferric Chloride Solution, this will detect the smallest quantity of free Acid by violet colouration at junction of the two liquids. Alcohol decomposes it. Chloroform is unsuitable.

BISMUTHI SUBNITRAS.

Dragendorff's Test for Alkaloids.—Bismuth Subnitrate 8, Nitric Acid, Sp. Gr. 1.18, 20; add this solution gradually to a concentrated solution of Potassium Iodide 22.7. Cool, decant from Potassium Nitrate formed and dilute to 100 with water. The solution precipitates most alkaloids.

A suggested modification.—Dissolve Bismuth Carbonate 64 in Hydrochloric Acid 85 and add Water 500 containing Potassium Iodide 166. Finally make up with Water to 800. This eliminates Nitric Acid which causes decomposition, and the proportion of Potassium Iodide is less. With this formula there is not the trouble with the crystals of Potassium Nitrate.

Thresh's Reagent.—Bismuth Citrate 2.4 Gm., Water 20 Cc., Ammonia g.s., made up to 30 Cc. with Water and add to a solution of Potassium Iodide 2 Gm. in Nitric Acid 45 Cc. Is similar in use to above.

Bismuthi Tartras Solubilis.

Estimation of Bismuth content in this compound is best conducted by weighing as Bismuth Sulphide. The ash may be titrated for the Sodium Carbonate. Bismuth cannot well be determined in the ash—there appears to be some loss on ignition. Free acidity which amounts to about 12 to 15% calculated as Tartaric Acid, is arrived at by titration of the original substance with (*e.g.*, 0.5 Gm.) with N/10 NaOH.

Metallic Bismuth is diamagnetic. It is a bad conductor of heat. It is used in making stereo-metal on account of its low fusion point—about 300° C.—P.J. ii./13,58.

BROMUM.

The following medicinal inorganic **Bromides** contain the halogen in these proportions:—Ammonium Bromide (NH_4Br = 97.962) 81.58%, Calcium Bromide U.S. (CaBr_2 = 199.91) 79.95%, Lithium Bromide U.S. (LiBr = 86.86) 92.01%, Potassium Bromide (KBr = 119.02) 67.14%, Rubidium Bromide (RbBr = 165.37) 48.3%, Sodium Bromide, (anhydrous) (NaBr = 102.92) 77.6%, Strontium Bromide *Off.* ($\text{SrBr}_2 + 6\text{H}_2\text{O}$ = 355.566) 44.95% (if exsiccated about 64.59%), Zinc Bromide (ZnBr_2 = 225.21) 70.9%.

ORGANIC BROMINE COMPOUNDS.

The amount of Bromine in daily doses of Organic Bromine Compounds is considerably less than the quantity in average doses of Alkaline Bromides *e.g.*, that of Potassium.

BROMINE IN DAILY DOSE			
Potassium Bromide	60 grains	Bromalin	54 grains
Brominol (10%)	18 grains	Brometone	11.6 grains
Bromural	6.2 grains		

The exception is Bromalin which gives rise to toxic effects. These bodies are only non-toxic owing to the small amount of Bromine they contain, or yield to the organism, and therapeutic value is limited to those cases in which such small amounts are of use. It is pointed out that the fact that the Bromine-Sesame Oil Compounds generally have not obtained any wide application in epilepsy, where the results are easily gauged, suggests that the Iodine analogues are equally inactive, but the cases in which they are employed do not give such definite indications of efficacy (or otherwise) of the therapeutic agent adopted.—Fortescue Brickdale, B.M.J. ii./10,1597.

Method of Bromination with Aqueous Hypobromous Acid.

The use of hypobromous acid, prepared by digesting bromine and H_2O with excess of HgO , in the form of a straw-yellow solution containing about 6.2% of Br., is suggested as a brominating agent. It suffices to shake this in the cold with C_6H_6 ; $C_6H_5CH_3$, or C_6H_5COOH to obtain satisfactory yields of mono-bromobenzene, *o*- and *p*-bromotoluene, *m*-bromobenzoic acid. Aniline yields tribromaniline; phenol gives tribromophenol under similar conditions; nitrobenzene resists bromination, as also does phthalic acid.—J.C.S.A. i./10,234

CAFFEINA.

Caffeine and Theobromine fail to precipitate with Mayer's Reagent, distinguishing them from the majority of alkaloids. Caffeine has a bitter, not agreeable taste. Tea contains a minimum of 3.5% of Caffeine and a maximum of 4.0% (L. ii./10,143,210.) Raw coffee about 1.2% and when roasted about 1.3%. For manufacture, tea dust with the strongest yield of alkaloid is extracted.

TEA.—When there is neither caffeine nor tannin present in quantity exceeding that which the compound of them (caffeine tannate) contains, the tea is pronounced by the taster as of good quality. Caffeine and tannin occur mostly (in good teas) in the ratio of 1:3—which is virtually the ratio in Caffeine tannate.—L. i./11,46.

TEA INFUSIONS.—Cold water extracts only a very small proportion of the total Caffeine in Tea, though solubility is 1.35 per cent. at 16° C. Caffeine is taken up always as Tannate.—L. i./13,844. *c.f.* A note on a "Cup of Coffee" vol. I. p. 243.

ESTIMATION OF CAFFEINE IN PRESENCE OF ACETANILIDE, *e.g.*, in headache powders; extract from a sulphuric acid solution with chloroform. Precipitate with iodine and decompose the periodide with sodium sulphite, and extract the base again with chloroform.—C.D. ii./04,469.

On the coronary vessels Caffeine, Theobromine and Theophylline claimed to have active vasodilator action, Caffeine being the weakest and Theobromine the strongest. In angina pectoris coronary vasodilation by the latter may be of service.—R. St. A. Heathcote, J1. Pharm. & Exp. Therap., Dec. 1920.

Caffeine hinders germination of seeds.—L. i./12,666.

Determination of Caffeine in Caffeine-Sodium-Salicylate. The method of P.G.V. shaking out 5 Cc. of a 20% solution with 5 Cc. of Chloroform gives result at least 5% too low. For modification *vide* Apoth. Zeit, 1911, 26.647; P.J. ii./11,437,463.

Maté.

Analysis showed Caffeine 2.02%, Sugar as Glucose 6.08%, Tannin 11.22%—3 and 10 minutes infusion (the 10 minutes being on the old marc) at about 90° gave total dissolved substances respectively 21.8%, 31.8%, organic matter 19.4%, 28.4%. Mineral Matter (Ash) 2.4%, 3%, Tannin 7.68%, 11.08% and Caffeine 1.39% and 1.70%. The second figures in each case indicating totals. The best method of preparing the 'Tea' is by first moistening the leaf thoroughly with boiling water, and then after a few minutes, adding the remainder of the boiling water and allowing to infuse for 15 minutes.—P.J. i./10,787.

A mild heart stimulant if taken periodically. Leaving it off after having taken it for some time may cause prostration.—P.J. i./11,3. Mortality from heart disease in Argentine is greater than elsewhere—asccribed to Maté. Test for distinguishing between Infusions of Tea and Maté—P.J. i./12,125.

Caffeine has been isolated from Maté leaves, but "Matteine" said not to occur in the leaves.—J. Chem. Soc. 101, II., 1086.

Maté comes from Brazil—the third most important export—mostly from the State of Parana where it grows wild, also in the state of Matto Grosso, Rio Grande do Sul, Santa Catharina, and Sao Paulo. In the three years 1911 to 1913 nearly 200,000 tons were exported.—P.J. ii./15,190.

CALCIUM.

Calcium Metal.

The method of manufacture consists in electrolysing fused calcium chloride with an iron cathode which only just touches the surface of the salt and can be moved outwards so as to produce ingots of the metal. Its density is 1.548, M.Pt. 810° C. Can be drawn out into a very fine wire, being tenacious. Is only slightly acted upon by water, but combines with hydrogen and with nitrogen.

For Chemical Uses, see P.J. i./05,721.

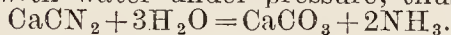
Calcium may be estimated *volumetrically* by precipitating it under specified conditions with excess of Ammonium Oxalate, the excess of which is subsequently titrated in the filtrate by means of Potassium Permanganate.—Abst. Ann. Rep. Chem. Soc. 1919 (Vol. XV.), p.136.

Calcium Carbide. $\text{CaC}_2 = 64.08$.

(Requires special storing.)

Blackish crystalline masses, resembling small pieces of coal. Evolves acetylene when brought into contact with water. May be used as a test for, and in the preparation of, absolute alcohol.—P.J. i./98,139.

When nitrogen is passed over calcium carbide heated to 1000° C. **Calcium Cyanamide**, $\text{CaCN}_2 = 80.095$, is formed. $\text{CaC}_2 + \text{N}_2 = \text{CaCN}_2 + \text{C}$. The nitrogen of same interacts with water under pressure, thus:—



The nitrogen must first be freed from oxygen. This is effected by fractional distillation of liquid air.

The above method of fixing atmospheric nitrogen is the **Frank-Caro** process. The cyanamide is used for manure. For details of manufacture see P.J. i./16,45.

Another—the production of Calcium Nitrate is that of **Birkeland-Eyde**.

A third is the production of nitrous fumes by passing air through an iron tube in which an alternating current arc of 5 metre length is maintained under a pressure of 4,200 volts.—SCHOENHERR and HESZBERGER. The gas obtained is mixed with limestone, forming Calcium Nitrate, the 'Air Saltpetre.'—Na., Nov. 25/09, p. 114.

Hydrogen from Coal and Nitrogen from the Air to produce Ammonium Sulphate.—Works in Cumberland.—L. i./20,210.

CALCII CHLORIDUM.

"A. R."—Should be clearly soluble in water and neutral. For Barium and Strontium 1 Gm. in 10 Cc. of water should not show any turbidity after adding 20 Cc. of Calcium Sulphate solution and standing several hours. For Iron and heavy metals 1 Gm. in 20 Cc. of water and 5 drops of Ammonia solution should not show darkening or discoloration on adding 5 drops of Ammonium Sulphide solution. For Nitrate 0.1 Gm. dissolved in strong Sulphuric Acid should not give a blue colour on adding Diphenyl-amine Reagent—*q.v.*

Calcium Chloride given in excess may cause clotting of the blood. **Blair Bell's Calcimeter** is used for estimating Lime Salts in the blood, urine and other fluids. If lime be in excess, Citric Acid treatment may be needed.—B.M.J. i./07,717.

The Calcium Oxalate crystals formed by mixing a known volume with Oxalic Acid are counted:—

250 c.mm. of an Aqueous Solution of Oxalic Acid (1 in 30) are mixed with 100 c.mm. of blood (the necessary graduated pipette for the blood and capsule of the solution are taken to the bedside of the patient). After time has elapsed (10 minutes) for the Calcium and Magnesium to be combined, 250 c.mm. of a mixture composed of Acetic Acid (1%) 95 parts and Glycerin 5 parts are added—this dissolves Magnesium Salts. Then after a further 10 minutes add 100 c.mm. of the mixture to 500 c.mm. of Distilled water. A drop of this final dilution is counted on a Thoma Zeiss Cell. Count the number of crystals in 250 squares—1 crystal per square gives the Calcium Index 1. Normal human blood gives an average of 0·8 to 1·0 crystal per square if the specimen be taken early in the day. Great accuracy in measuring is essential.—Sir James Barr, B.M.J. ii./10,830.

Some observations seem to indicate that pregnancy is terminated when the foetus ceases to absorb or receive Calcium Salts from the mother's blood and a large accumulation occurs in her system.

Calcium Estimation in Urine.—The lime is thrown out by a **Reagent** consisting of a Saturated Solution of Oxalic Acid in 5% Solution of Acetic Acid. The volume of the precipitate is compared in a specially graduated centrifuge tube with that produced with a **Standard Solution** of Calcium Phosphate $\text{Ca}_3(\text{PO}_4)_2$ —prepared by dissolving 0·05 Gm. in a little Hydrochloric Acid, making alkaline with Ammonia and then Acid with Acetic Acid. Finally 2 Gm. of Urea are added and the whole diluted to 100 Cc. Sp. Gr. of the product is about 1015.—B.M.J. i./12,878.

In practice 5 Cc. of urine—24 hours specimen,—is rendered faintly acid with Hydrochloric Acid to dissolve any insoluble Phosphates and then made faintly alkaline with Ammonia and filtered—5 Cc. of the filtrate are placed in a special graduated centrifuge tube and 5 Cc. of Standard Calcium Phosphate Solution *as above* in another. 1 Cc. of Reagent, consisting of a saturated solution of Oxalic Acid in 5% solution of Acetic Acid, is added and 2 Cc. of Alcohol to each tube and thoroughly shaken. After centrifugalising 15 minutes the volumes of the two precipitates are compared. Then the per-

centage of Calcium in the urine is ascertained from the formula $\frac{U}{S} \times \frac{1}{50}$ in

which U = height in millimetres of precipitate in the urine examined and S = height in millimetres of precipitate in the standard solution. If the urine contains an unusually large amount of Calcium, so that the precipitate more than fills the calibrated portion of the tube, it is to be diluted and the test repeated.

In the puerperal state the coagulation time immediately after delivery is below normal. Determination of the time might prove useful after delivery to indicate risk of thrombosis or embolism if the time be low, or of post-partum hæmorrhage if high. Treatment as above could then be employed.—L. i./08,99.

There is a connexion between thyroid secretion and Calcium metabolism also intimate connexion between pituitary extract and Calcium metabolism—under the influence of the extract there is an increase of Calcium. Adrenal Extract causes Calcium retention. The ovaries influence Calcium metabolism (osteomalacia has been cured by oophorectomy and Calcium retention occurs after the menopause). The ductless glands more than probably preserve a balance in the Calcium metabolism—one acting anabolically, another katabolically. Subsequent papers to indicate more fully the connexion existing between these glands and the functions of the female genital apparatus.—B.M.J. i./09,517.

In most cases of exophthalmic goitre (thyroid secretion in excess) the Calcium index was low, hence administration of Calcium salts may be advantageous.

Further work on the subject of menstruation gave *inter alia* the conclusion that menstruation is a periodic function only in so far as the Calcium meta-

bolism is in harmony with this periodicity, and that the function is dependent on Calcium metabolism in all its ramifications.—B.M.J. i./09,592.

Ammonium Oxalate prevents coagulation of the blood by precipitating Calcium, the presence of which is thought to be essential to coagulation.—P.J. ii./09,657.

As hæmostatic Calcium Chloride should be given intramuscularly. Hypodermically it may produce sloughing even in 1 grain doses.—B.M.J. i./20,47.

Calx Chlorinata.—According to recent views, when moist CO_2 acts on bleaching powder Chlorine only is given off (no Hypochlorous Acid as originally taught). Air free from CO_2 very slowly liberates Hypochlorous Acid, but no Chlorine. With air containing CO_2 a mixture of Hypochlorous Acid and Chlorine is obtained, the proportion of the former decreasing with time. These points are explained on assumption that the action of Chlorine on alkalis is reversible.



The action of air in promoting bleaching is therefore due to removal of Lime from the powder by CO_2 .—P.J. ii./10,584. The bleaching action is further accelerated by the addition of Common Salt or Calcium Chloride.

Water Sterilization with Chlorinated Lime. See Vol. I., p. 50, and Horrocks's Water Testing method in the Water Analysis Chapter.

CAMPHOR.

Camphor Production.—The leaves are the best parts of the tree to use. Yield 1% or more of crude Camphor.—Schimmell's Rep., Oct., 1912, Y.B.P. 1913,70.

Camphor Estimation (in Spirit of Camphor). Place 10 Cc. in a conical flask (= 1 Gm. Camphor) and add 4 volumes of Lead Subacetate Solution (Sp. Gr. 1.320) and shake. The Camphor collects as a cake on the top. The liquid contains some more in suspension. Filter in a cool place (covered). Wash flask with Ether and pour this on the filter, then wash with more Ether until all Camphor is extracted, collect Solution in a tared dish. Evaporate spontaneously, place in desiccator and weigh.—P.J. ii./13,881.

Artificial Camphor has been manufactured by acting on turpentine with various acids.

The possibility of competing with ordinary Japanese camphor depends on the market value of turpentine. Pinene ($\text{C}_{10}\text{H}_{16}$) is obtained by fractional distillation of oil of turpentine previously freed from resin. The pinene saturated with dry hydrochloric acid is the old-fashioned artificial camphor. The subsequent processes consist of splitting off the hydrochloric acid to obtain camphene, which is isomorphous with pinene. This substance, dissolved in glacial acetic acid, with a little sulphuric acid, yields bornyl acetate, and this saponified becomes borneol, which is identical with Borneo camphor. After oxidation synthetic camphor results, and this corresponds exactly with the Japanese and Chinese camphor, except in optical properties.—Houseman.

The synthetic is optically inactive, therefore is strictly not official. The *Off.* body is dextrorotatory, and a test for Artificial Camphor is also given in spiritus Camphoræ. Synthetic Camphor has M.Pt. 165°C ., whilst natural has M.Pt. 175°C .—*c.f.*, also Ph. Ital.

CANNABIS INDICA. (*Off.*).

Has been imported from East Africa to avoid the Indian duty. It is not so effective as the Indian. The extractive is about the same, but it contains less resin. The physiological test is the only safe one. Foreign cigarettes frequently adulterated with Indian hemp, in the paper and the gum,—needs verification.—Holmes, P.J. ii./09,132.

Off. requires that the drug should yield not less than $12\frac{1}{2}\%$ extract to 90% alcohol and Ash not more than 15%.

A pharmacological study of *C. Americana*, i.e., *C. Sativa* grown in America—it is quite as active as that imported. Determination of physiological activity by internal administration to selected dogs is reliable when the standard dose 0.010 per kilo body weight, is tested in comparison with the same quantity of a preparation of known strength.—Am. Jl. Ph., Jan. '08,20.

Pharmacological Examination.

U.S. IX. Assay Method.

A standard fluid extract is employed for comparison with the sample to be tested. The standard is a fluid extract made according to U.S. IX. which will produce incoordination when given to a dog in the dose of 0.03 Cc. ($\frac{1}{2}$ minim) for each 1,000 Gm. of body weight. When given in the form of extract (U.S.) a dose of 0.004 Gm. ($\frac{1}{16}$ grain) for each 1,000 Gm. should produce similar symptoms. For the tincture (1 in 10) the requirement is 0.3 Cc. (5 minims) for each 1,000 Gm. The dose is given in soft pill or gelatin capsule form.

The incoordination varies in different animals; in small doses its signs are slight swaying movement when standing quietly, or in some ataxia when the animal runs about.

For full details see U.S.P. IX., p. 605.

The determination of the Iodine Number of fractional distillates, though advocated as a method of determining activity of a sample, is of no certain value as a means of estimating pharmacological activity, and hence is unsuitable as a substitute for physiological standardisation.—B.M.J. i./11,1171; P.J. i./11,739; C.D. i./11,854.

Charas is an intoxicating resinous substance secreted in the upper leaves and flowering spikes. Enzymes decompose Cannabis. Recommendation to import alcoholic extract in small sealed bottles. Production, adulteration, valuation, etc.—P.J. ii./08,80,347,405.

Test for recognition of Hashish.

The suspected material is extracted with petroleum ether of low boiling point, and which leaves no perceptible residue when evaporated in the cold. The petroleum-ether extract is separated, filtered, and evaporated to dryness in a porcelain capsule. Both extraction and evaporation should be carried out in the cold. In presence of a considerable quantity of hashish a marked amount of tar-like residue is obtained, but it is sufficient for the reaction if only a faint yellow stain is left. To the residue a weak alcoholic solution of potash or soda (about N/10) is added and the liquid allowed to evaporate at room temperature. In presence of hashish a very permanent rich purple or reddish purple colour, due to the formation of an oxidation product, gradually develops, which, on dilution with water, takes on a more bluish cast. Any of the ordinary resin solvents may be used, but petroleum ether appears to be most satisfactory. Hashish, however, is frequently sold dissolved in fat or oil, and for such preparations alcohol is the best solvent. It was noted that the extract of Indian hemp of the Pharmacopœia does not respond to this test, and no investigation it was found that certain genuine samples of Indian hemp from Ceylon did not respond to the test. Samples of ganja, charas, and majun from India and a plant grown in Egypt responded perfectly. The ordinary hashish sold in Egypt is largely of Greek origin, and of a large number of samples tested since 1909 not one has failed to respond to the test. These results, it is stated, show that the influence of soil, climate, method of cultivation, and curing have even greater influence on the chemical composition of the plant than was suspected. The following is suggested as a useful presumptive test to which hashish or other *Cannabis* preparations from India, Egypt, Greece, Sudan, and Uganda all respond. The petroleum-ether extract is made as usual, and the evaporation of the solvent is carried out in a short test-tube. To the residue is added a few cubic centimetres of a reagent prepared by saturating absolute alcohol with dry hydrogen chloride gas. In the presence of *Cannabis* extract the liquid strikes a bright cherry-red colour which disappears on dilution with alcohol or water. Trials were made with a number of plant extracts and over 200 alkaloids, glucosides, etc., but in no case was a similar reaction obtained. Certain volatile oils—*e.g.*, origanum and santal—give a similar reaction, but the colour is far less intense for similar amounts of material.—W. Beau, Wellcome Res. Lab., Khartoum, C.D. Jan. 1/16.

CANTHARIS.

Cantharides should contain not less than 0.5% Cantharidin.—P.G. has 0.8%. FR. CX. 0.4%. U.S. IX. not less than 0.6%.

Assay process (Greenish); by extraction with benzene.—P.J. i./07,322 *et seq.*

Gaze's Assay process for galenical preparations of the drug: 50 Cc. of (for example) the tincture is evaporated to dryness with 25 Cc. of water and 1 Cc. of a 30% solution of Sodium Carbonate. The residue is taken up with 10 Cc. of water and 2 Cc. of 25% hydrochloric acid, the liquid transferred to a small separator and extracted with four separate portions of 10, 5, 5, and 5 Cc. of chloroform. The chloroform is evaporated at a low temperature, and the residue allowed to stand at ordinary temperature for twelve hours. It is then treated with two successive small portions of petroleum ether, each being poured on to a small filter, the residue and the filter washed first with water containing a trace of ammonium carbonate, then with pure water, and then dried at 50°. The portion remaining undissolved in the flask is treated with warm acetone, which is passed through the filter, which is further washed with acetone, and the brownish residue is dried on a water-bath to constant temperature and weighed. ("Apotheker Zeitung," 1911, p. 332, per C.D.)

CAOUTCHOUC.

For India Rubber and substitutes, Properties and analysis, see Allen, 4th Edn., 1911, Vol. IV., 105—161, Gutta Percha (*ibid.*, p. 156—161).

For latest information on Rubber from cultural, etc., aspect, consult works advised by the "India Rubber Journal," London.

Rubber substitutes.—See Nature, Mar. 17, 1910, p. 71.

Synthetic Rubber.—Processes of manufacture depend on polymerising isoprene. According to Harries (C.D. i./10,121), this is effected by heating with Glacial Acetic Acid in closed containers to above 100° C.

India rubber is a condensation product of $C_{10}H_{16}$. This group is common to Turpentine and the Terpenes, in many essential oils. Synthetic Camphor is made from Turpentine. Synthetic Rubber has been made from $C_{10}H_{16}$, in some form or other. Nature elaborates many useful things from this base.—L. i./12,595.

Plaster Mull Basis.—Melt White Wax 1 with Lard $3\frac{1}{2}$ with gentle heat and pour it slowly on to India Rubber Paste (1 in 10) 5 parts continually stirring until intimately mixed. The quantity of solids in this paste is 5 to $9\frac{1}{2}$. To prepare a 50% Mullplast a quantity of medicament equal in weight in the solids in the paste must be added. Starch may be used in diluting, e.g. for the various strengths of Salicylic Acid.

The Salicylic Acid Mulls when originally introduced were found to be painful in use for the removal of cuticle and in treatment of skin affections. Creosote was therefore added.

India Rubber Paste is made by soaking India Rubber in Benzole. Rubber is better than Gutta Percha. Unvulcanised rubber is wanted.—A. W. Gerrard, B.P. Conf., 1920. In discussion it was said that the plasters would not keep. Nearly 30% of rubber is wanted.

CASCARA SAGRADA.

Tschirch has isolated a principle anthra-gluco-sagradin, and similar principles from Rhubarb, Senna and Rhamnus.

Oxymethylantraquinones are characteristic constituents of purgative drugs from widely separated natural orders, e.g., Rhamnus (*Rhamnaceæ*), Cassia (*Leguminosæ*), Quassia (*Simarubaceæ*), Aloe (*Liliaceæ*)—Tschirch, P.J. ii./09, 421.

The characteristic aperient action is not due to Emodin. Emodin is, however, a constituent, but chrysophanic acid or chrysarobin could not be found. Apparently no chemical differences between one and three year old ('matured') bark. This was said to exhaust a ferment and to moderate the griping action which the fresh bark possesses.—B. & C.D. ii./04,268.

Assay of the oxymethylantraquinone drugs.—Tschirch, P.J. ii./05,225,248.

Further methods of determination on colorimetric principles.—P.J. ii./05,229.

Cascara glucoside,—a patented method of extraction.—P.J. ii./09,696.

The refractive indices of commercial fluid extracts of Cascara Sagrada found to agree with the specific gravity and amount of extractive. The refractive index would be useful in indicating that the extractive of galenicals is free from extraneous matter.—C.D. ii./09,185.

The medullary ray cells in *Rhamnus Purshiana*. Microscopic investigation.—H. Kraemer, Am. Jl. Ph., Sept., 1912.

CERIUM. Ce = 140.25.

This element, in addition to lanthanum and didymium, occurs as silicate. in Cerite and as phosphate in Monazite, also in Samarskite and Gadolinite. Monazite is a mineral of fairly wide distribution in Brazil (in the State of Rio de Janeiro). For commercial details *vide* P.J. ii./09,492. Cerium has Sp. Gr. 6.7, Lanthanum 6.1, and Didymium 6.5. The last mentioned has been split up into Praseodymium = 140.9 and Neodymium = 144.3. Cerium possesses a variable valency. It is, like aluminium, either trivalent, or in some compounds apparently tetravalent, or even hexavalent as in the peroxide CeO_3 , in this respect differing from the majority of the rarer earth metals and resembling the elements which are known to possess physiological action, for example iron, arsenic, antimony and iodine. Cerium oxide is contained in incandescent gaslight mantles. The filament in Nernst lamps is said to contain zirconia and yttria.

RUTILE is the ore Titanium Dioxide used in leather dyeing.—C.D.

The best result in manufacture of Titanium Metal was obtained by reducing Titanium Chloride (TiCl_4) with Sodium by heat in a steel bomb. Titanium, practically 100% pure, was obtained. Sp. Gr. of the metal is 4.5 (Moissan found 4.87). It is brittle in large pieces when cold, but is remarkably malleable at a dull red heat.—Chem. News, May 20, 1910, 232.

For details of Cerium Oxalate, Sulphocarbolate, etc., *vide* Vol. 1, p. 788, 789.

CHLOROFORM.

A. D. Waller by experiments on striated muscle states that the physiological power of chloroform is 12 times that of ether and 100 times that of alcohol.—Proc. Phys. Soc., Dec. 1908. L. ii/09,369.

Books give three different equations to represent the reaction between Chlorinated Lime and Alcohol. The one in which three molecules of alcohol yield two of Chloroform agrees best with practice.—C.D. Feb. '08. The method of manufacture is now so perfected that we may safely say it is almost impossible to purchase impure "Chloroform for Anæsthesia"—a number of tests have therefore been omitted.—*Vide* B.P.

In determination of the **Boiling Point** of chloroform it is important to transfer about the last 15% in the flask into a smaller flask or tube, otherwise it will be found in practice that this portion may refuse to pass over below 65 to 70° C.

Test for Decomposition of Chloroform:—

Small pieces of Pith steeped in Congo Red Solution. Acidity would cause the Congo Red dye to change to blue.—L. i./07,1033.

"A. R."—For Chlorine shake 5 Cc. with 10 Cc. of water. Add a few drops of solution of Cadmium Iodide to a portion of the aqueous layer removed and then starch paste. There should be no blue colour.

The drug is stated to be absorbed by the corpuscles rather than by the plasma of the blood. 'Carius' analyses best for estimating.—In chloroform narcosis the transport of chloroform from and to the lungs is a function of the red corpuscles.—Na. Jan. 9/08, (B.M.A. Inquiry).

Chloroform is toxic for heart muscle. Adrenalin is contraindicated wherever Chloroform is employed and *vice versa*.—W. J. R. Heinekamp., Jl. Pharm. and Exp. Therap., Nov. 1920.

Tetrachlorethane is also known as **Acetylene Tetrachloride** and by the trade name of **Cellon**. It is a good solvent of resins, Cellulose Acetate, etc. *c.f.* Vol. I., pp. 287, 440.

CHRYSAROBINUM.

May be converted into Chrysophanic Acid $\text{C}_{14}\text{H}_5(\text{CH}_3)(\text{OH})_2\text{O}_2 = 204.15$ by oxidation in alkaline solution and subsequent precipitation of the acid: $\text{C}_{30}\text{H}_{26}\text{O}_7 + 2\text{O}_2 = 2\text{C}_{14}\text{H}_5(\text{CH}_3)(\text{OH})_2\text{O}_2 + 3\text{H}_2\text{O}$.

Prof. Unna found that the oxidation of chrysarobin when same is applied for healing upon the skin is due to the presence of oleic acid on the skin surface and the product formed is the remedial agent. He states that he proved that oleic acid present was sufficient to oxidise chrysarobin. This was facilitated by the discovery that chrysarobin dissolved in benzol has a characteristic spectrum, which, during oxidation, also changes. It is characterised by two bands in the green lying closely together (535 and 510). If, however, the chrysarobin is oxidised in absence of alkalies, the spectrum shows only a

broad indistinct band in the green and an obscuration in the yellow. This new body is to be called *oxychrysarobin* until its exact constitution is known. If we oxidise chrysarobin by means of oleic acid which has been in contact with air for some time, or by heated linseed oil (*siccatis*), by benzoyl peroxide, by oleate of lead, or by persulphate of ammonia, oxychrysarobin in increasing degree results. If air is passed, on the other hand, through an alkaline solution of chrysarobin, we get chrysophanates; but if this be continued for a long time the change goes further, and finally, after adding acids, we get another product, easily soluble in benzol, which has also a characteristic spectrum—namely, an indistinct band in the green and chiefly a dark, sharply defined band in the red (625): this product to be called '**Chrysaloxin.**' It is recommended that for a quick and thorough treatment of psoriasis chrysarobin *siccatis* and ointments containing, besides chrysarobin, oleate of lead, should be freely used.—B.M.J. ii./10,1593.

CINCHONÆ CORTEX.

The cultivation of the Cinchonas is carried on in India, in the Nilgiri Hills in the south, and near Darjeeling in the north-east, also in Ceylon, Java, and Jamaica.

The species *C. succirubra* has proved to be the hardiest and most easily propagated, and although on analysis the yield of cinchonidine and quinidine generally preponderates over that of quinine, yet the total yield—often up to 10%—of alkaloids from the bark of this Cinchona is very large (especially in the hybrids with *C. officinalis*): latterly the proportion of quinine in it has increased.

By far the largest proportion of the barks worked for quinine is Java *Ledgeriana* bark, all derived from the packet of seed obtained from one great tree by the Indian Manuel, and brought over by Ledger, which cost the Dutch Government £50 and Manuel his life. Of this bark Java produces nine to ten millions of pounds per annum, average test over 6% of sulphate of quinine, exceptional samples testing 10 to 12%. Much smaller quantities of *Calisaya* from South America, *Officinalis* from India and Ceylon, and *Succirubra* from India, Ceylon and Java, are also used, the latter being sought after by manufacturers of Pharmacopœia Germanica II. Quinine, which allows 10% or thereabout of Cinchonidine Java Bark is year by year increasing in alkaloid content.—(Howard).

Cinchona Culture in India.—80,000 lbs. of Quinine Sulphate in a year from two factories near Darjeeling in N. India and in the Nilgiri Hills in S. India.—D. Hooper, P.J. ii./16,50.

"Grey" Cinchona Bark from Huanuco has recently reappeared on the market. Found to contain Quinine 0.45%, Cinchonidine 0.22%, Cinchonine 0.63%, Amorphous Alkaloid 0.48%.

A further sample of S. American Bark contained 5.49% Cinchonine and only 0.027% Quinine. It consisted of *C. nitida* and other vars., and was also "Grey" Bark. The abnormal content of Cinchonine probably due to cultivation or growth at low altitudes and in hot moist atmosphere.—B. F. Howard and O. Chick, B.P. Conf., 1920.

Assay Methods.—Gadd, P.J. ii./05,579.

Alpha-Naphthol Test for Cinchona Alkaloids.—

Added to an Aqueous Solution of Quinine Sulphate, a few drops of fresh saturated alcoholic Alpha Naphthol Solution to which a few drops of Concentrated Sulphuric Acid (2 drops per Cc.) have been added, produces a yellow precipitate, when Reagent is in excess a yellow solution results. Quinidine, Cinchonidine and Cinchonine Sulphates act likewise. No other white alkaloids appear to give it. Cinchona alkaloids can thus be detected in presence of Atropine, Morphine, Cocaine, Strychnine, Caffeine, Brucine, Codeine and Antipyrine. A drop of the Reagent added to Chloroform or Ether residues of any of the Cinchona alkaloids gives yellow colour. We find this test to work satisfactorily.—Watson, Am. Jl. Ph. 1913,502; P.J. ii./13,881; C.D. i./14,84.

Extractum Cinchonæ Liquidum (Off.).

Cinchona does not extract so readily with acetic acid as with alcohol and glycerin, but it gives a more permanent extract.—P. J.ii./09,142.

Methods of assay.—P.J. i./03,268; Y.B.P., 1902,55,56.

The B.P. method of making and of assay are unsatisfactory. The extraction is by no means complete—only 15 to 40% of the actual content in alkaloids are removed.—Oliver Chick, P.J. ii./16,144.

Nephelometric estimation of Quinine in blood and urine after administration in treatment, employing Tanret's Reagent. The ether used is purified so that it gives no reaction for aldehydes with Schiff's reagent or for Ketones with **Scott Wilson's Reagent** see p. 17. No turbidity must develop on shaking the ether with excess of the reagent.—I. J. Lipkin and W. Ramsden, B.M.J. i./18,560.

CINCHONA FEBRIFUGE, see p. 140.

CINNAMOMI OLEUM (*Off.*).

A test to ensure absence of cinnamon-leaf and cassia oils is given—*Off* Further, it should now contain 55 to 65% of cinnamic aldehyde as determined by a sodium sulphite addition process.

The Bisulphite method is more commonly used, *c.f.* other Pharmacopœias.

See also note on Bark oil: experiments in distilling showed that Sp. Gr. higher than 1.016 could not be obtained. Opinion is expressed that the characters hitherto accepted for the oil have not been based on normal distillates.—P.J. ii./10,145.

There is no difficulty in obtaining shipment of Cassia Oil with over 90% Cinnamic Aldehyde. Practically all the oil of 80 to 85% is adulterated with Resin or something similar.—P.R., Dec., 1913,402.

CITRONELLÆ OLEUM.

Genuine Oil from Ceylon Government gave the following figures: Sp Gr. at 15.5° C., 0.884. Optical rotation—3.3, Citronellal 36%, Geranio 41%. Schimmel's Test. Turbid solution.—C.D. i./06,355.

Citronella Oil with Carbohc Acid acts admirably in driving off mosquitos. (Cairo).—Ph. Notes. **Bamber Oil** contains this and Kerosene, *v. Malaria*.

The tse-tse fly has marked repugnancy to the plant.—L. i./09,701 (*c.f.* trypanosomiasis) but it has been tried (L. ii./09,1197) and has lost its reputation as a means of warding off the insect—the odour of the oil is not given off without bruising the plant.

Citronellol and Citronellal described, see Allen, 4th Edn., 1911, Vol. IV.. p. 263-269.

The *Perfumery Record* (Nov. 1911) criticised Schimmel's 'Test' for Citronella Oil as contained in their Report. This test is arbitrary and not to be compared with an Acetylising method. Schimmel thinks that no water is formed in the acetylation of Geraniol. Dry, *i.e.*, Fused Sodium Acetate is, however, always employed for the purpose. $2ROH + (CH_3CO)_2O = 2RO(OCCH_3) + H_2O$. Schimmel maintains on the other hand that the action of Sodium Acetate is a catalytic one.—C.D. ii./11,787. See also P.R., 1913 167; Y.B.P., 1913,75.

COAL TAR DERIVATIVES.

Methylene Blue (Medicinal).

N.B.—Distinguish carefully from the commercial article containing zinc chloride. Test for this by incinerating and dissolving the residue in dilute Hydrochloric Acid with the addition of Nitric Acid. On adding Ammonia in excess and passing H_2S through the solution there should be no precipitate.

Medicinal Methylene blue is preferable to the commercial for making alcoholic solutions for bacteriological staining, as being more soluble, *c.f.* Löffler's Alkaline Methylene Blue.

Malaria treated by Methylene Blue—experience of 5,000 three grain doses. Though inferior to Quinine in cutting short attacks it is valuable in preventing relapses. No fear of 'toxic' symptoms.—D. G. Marshall, L. i./20,1334.

Methylene Blue as Indicator in Iodometric Titrations.

When titrating with standard iodine, the usual starch indicator may be replaced by methylene blue. Use a solution of 0.05 Gm. in Water 1,000 Cc. 1 Cc. of this is added to 50 Cc. of the solution to be titrated. The end point is the change from blue to yellowish-green.—J.C.S.A. ii./10,747. An indicator is hardly necessary in Iodometric titrations—W.H.M.

TESTS FOR PERMEABILITY OF THE KIDNEY.

Methylene Blue Test.—1 Cc. of 1 in 20 solution is injected into the gluteus maximus and the urine is turned pale green. **Sterules** of this strength are prepared.

The method is sufficient to compare the work of the two kidneys. Both the Methylene Blue and Phloridzin test are trustworthy.

Discussion on the elimination of Methylene Blue.—Chromogen usually appears in 15 minutes, the blue in 30 minutes.—L. i./07,711.

Indigo-Carmine Solution 0.4%.

20 Cc. of 0.4% Solution (i.e., 0.08 Gm) of Indigo Carmine injected intramuscularly,—colour should appear in the urine in 10 to 12 minutes if functional capacity is in order. The 0.08 Gm. might be preferably dissolved in a *less quantity of water*—e.g., 5 Cc. This forms a practically saturated solution (1 in 60). Previously a stronger solution (4%) was advised but this is unattainable.

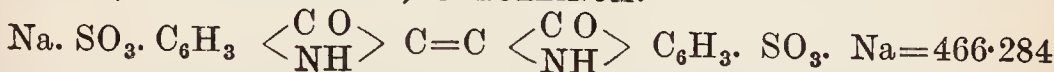
Cystoscopic examination of the urethral openings and the urine gives, by depth of colour, indication of renal functional power.—L. i./07,793.

Sahli's Pill.—To diagnose peptic activity of the gastric juice a pill of Methylene Blue is enclosed in catgut in the form of a so-called desmoid pocket and swallowed by the patient after dinner. As soon as the catgut is dissolved Methylene Blue escapes and dyes the urine, the time required to effect this result furnishing a measure of the condition of the gastric secretion. The Methylene Blue may be enclosed in a small piece of rubber tubing tied with thin catgut—the knot being touched with shellac.

Indigo or Indigotin (natural) is obtained from the shoots of *Indigofera Tinctoria* (*Leguminosæ*) in India and Java, by maceration with lime and water. The pure substance has the composition $C_{16}H_{10}N_2O_2$. For chemical synthesis, *v. Indican*.

Indigo Carmine is stated to be the Sodium Salt of Disulphindigotic Acid (which acid substance is Sulphate of Indigo, or Soluble Indigo) prepared by adding gradually Powdered Indigo 1 to Nordhausen Sulphuric Acid 5 or Oil of Vitriol 8—the vessel being kept surrounded by cold water.

Indigo Soluble. FR. CX. has *Syn.* Sodium INDIGO-DI-SULPHONATE, INDIGO CARMIN, CERULEINUM.



Completely *soluble* in warm but only slightly in cold water. Soluble Indigo as mostly understood is the acid substance not the sodium salt.

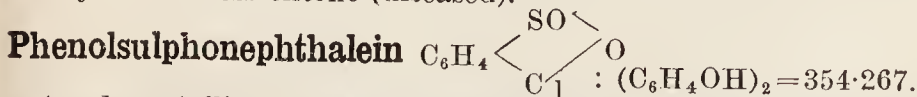
The Sodium Salt is formed as a precipitate on neutralising Soluble Indigo with a Sodium Salt. It has to be washed with a solution of the same salt—to remove excess of Sulphate of Indigo. The product is pressed and dried and is then soluble in water.

Isatin. $C_8H_5NO_2 = 147.09$. Yellowish red prismatic crystals obtainable by oxidising indigo with chromic or nitric acid, also by boiling o-nitro-phenyl propionic acid with caustic soda.

Phloridzin Test.—This consists in injecting 5 mgr. of phloridzin (*q.v.*) subcutaneously in 20 to 30 minims of water. Glucose should normally appear in the urine in half-an-hour.

For determining the diseased side of the kidney this test is also delicate.

The technique of Caspar's method consists in the subcutaneous injection into the buttock of 1 Cc. of 1% Phloridzin Solution and observation as to (a) excretion of sugar by a healthy kidney or (b) non-excretion at all or more slowly and to less extent (diseased).



A red crystalline substance slightly soluble in water, more soluble in Alcohol, insoluble in Ether. With alkalis it gives an intense purple red colour even in extreme dilutions.

Manufacture.—It may be prepared from Saccharin by hydrolysis and subsequent treatment of the anhydride of Sulphobenzoic Acid obtained therefrom with Phenol. *e.g.*, Saccharin 100 Gm. boiled with 1500 Cc. of water and 125 Cc. Concentrated Hydrochloric Acid until no longer sweet (4 to 6 hours), then evaporate to crystallise, collect crystals and evaporate the mother liquor to almost dryness and collect the crystals and dry them with the others. Distil the dried crystals thus obtained with an equal weight of P_2O_5 , this gives the anhydride of *o*-Sulphobenzoic Acid which is then fused with Phenol at $130^\circ C$. for several hours until combination is complete.—L. G. Rowntree and J. T. Geraghty, *Jl. Pharm. and Exptl. Therapeutics*.—Vol. i./1909-1910, p. 579.

Phenolsulphonephthalein Test,—Technique.

An aid in proving whether the diminished excretion of Nitrogen is due to interference with function and also as a guide to the degree of interference with renal function in toxæmia of pregnancy and threatened eclampsia.

Give 300 to 400 Cc. of water half an hour prior to the test. Empty the bladder with a catheter and give subcutaneously in the upper arm 6 mgr. of Phenolsulphonephthalein neutralised with Sodium Hydrate in 1 Cc. of water ('Sterules' of this strength are made).

Then allow the urine to drain through the catheter into a test tube containing a drop of 25% *Sodium Hydrate Solution* and note the time of the appearance of the first pink stage. Remove the catheter and determine colorimetrically the amount of the body excreted in the first and the second hour. Normally the drug appears in the urine in from 5 to 11 minutes and in the first hour from 38 to 60%, and in the second 22 to 25% are excreted. In severe, acute nephritis the permeability is markedly decreased, also in chronic interstitial nephritis. The delayed appearance and especially the diminished excretion in the two hour period are more accurate indications of functional derangement than an estimation of total solids or Nitrogen.

In 18 clinically normal pregnancies there was a relatively diminished excretion (*i.e.*, interference with renal function) as compared with that in normal non-pregnant cases. These data suggest that the depression in Nitrogen secretion in late pregnancy is due to interference in renal function and in absence of actual renal lesions the cause may be disturbed circulation due to pressure of the gravid uterus.—B.M.J.E. i./13,75.

Further report says, the rate of excretion is of less importance than the relative quantity excreted by each kidney and the fact whether the whole amount is excreted. The urinary pigment may be overcome by precipitating with Lead Acetate.—B.M.J.E., i./13,80.

Other observers require three hours as time. 60% should be excreted in this period.—M., 1912.

A recent report states as follows:—

The patient may drink 200—300 Cc. of water and then micturate so as to completely empty the bladder prior to the injection. The urine passed after 6—10—15 minutes is tested with alkali and the moment when elimination begins is indicated. For the estimation the urine passed in the first hour is collected, 10 to 15 Cc. of 15% NaOH added and diluted to 1 litre. A portion of this is then placed in the colorimeter which gives the actual percentage estimated. The same is done with the urine passed during the 2nd, 3rd and 4th hours.—L. i./15,386.

After intramuscular injection the bladder is emptied 1 hour and 10 minutes later, and every hour up to 3 or 4 hours. The amount excreted during the first hour should equal the total of the amounts passed at the end of the second and third hours. Better than the diastase test.—J. E. Adler, L. ii./16,865.

A. G. Auld (B.M.J., ii./17,414), in an Investigation of Trench Nephritis by means of the dye, mentions that the urine is collected after one hour and after two hours. After the addition of a few drops of 25% NaOH solution, the resulting pink colour, after dilution with water to 1 litre or its equivalent, is read off against tubes containing standard colour solutions of the dye. An excretion of 50% in an hour is a normal average and 25% in the second hour. The first hour's reading is sufficient. Rowntree and Geraghty think that investigations on the lines of urea output, total nitrogen, etc., are of no value.

PHENOLSULPHONEPHTHALEIN was also used in the investigation as an indicator for the **Hydrogen Ion concentration of the blood** and the **alveolar carbon dioxide tension** using acid and alkaline phosphate mixtures as standard solutions. It is the best indicator

for minute differences in the H ion concentration between $10^{-6.4}$ and $10^{-8.4}$ (passing through neutrality). In the case of the blood the H ion concentration is indicated in terms of the reserve alkalinity of the serum after driving off the CO_2 by a current of air. This is expressed as Rph. The serum is dialyzed through **Collodion sacs** and comparison made against standard tubes. Normally the reserve alkalinity is Rph 8.5 or near it.—Marriott, Arch. Int. Med., June 1916, and Jl. Amer. Med. Assn., May 20/16.

In the estimation of the alveolar CO_2 the air is collected by the Plesch method, the respirations into the bag (containing 1,000 Cc. of air) occupying 25 seconds. The respired air is then bubbled through a standard alkaline phthalein solution and compared with a set of phosphate-phthalein tubes.

Prof. Haldane provides references to the subject of methods of estimating H ion concentration in urine and blood—they are still, in respect to the latter, subject of acute controversy.—See B.M.J. ii./19, 295. See also *urther details* in the *Blood* chapter, p. 391.

Phenacetinum.

Manufacture.—For notes on the process of manufacture of Phenacetin whereby one molecule of para-nitrophenol is made to yield a large number of Phenacetin molecules, *vide* May.

The action of Aniline and Paraminophenol derivatives is within limits proportional to the amount of Aniline, Paraminophenol or Phenetidine formed in the organism. Several more soluble derivatives of Phenacetin have been made, *e.g.*, by introducing Sulphonic or Carboxylic radicals, but these only tend to spoil the physiological action—May, *c.f.*, also Lactyl-Phenetidine—the Lactyl analogue of the body under consideration.

The introduction of the acetyl group diminishes the formation of Phenetidin Hydrochloride, which is a poisonous body in the stomach.—J. M. Fortescue-Brickdale, B.M.J. i./15, 107.

Cold saturated solution treated with bromine water added drop by drop until the solution is permanently yellow should not become turbid (absence of acetanilide, B.P. & U.S.).

Pertonal. Para-acetyl-amido-ethoxybenzene. Stated to be only half as toxic as Phenacetin. Antipyretic effects similar in dose double those of the latter. Stimulant to the heart while Phenacetin is depressant. *Soluble* 1 in 60. 15 to 25 grain doses relieve neuralgia.—Jl. Pharmacology & Exptl. Therapeutics, Feb. 19, and L. ii./20, 506.

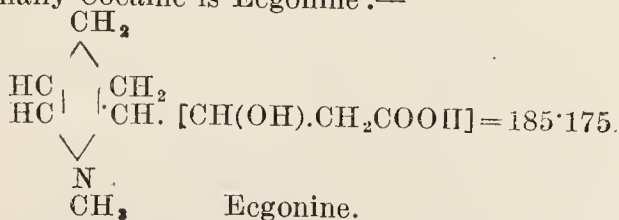
COCÆ FOLIA.

Assay.—Our examination of eight commercial samples of Coca leaves showed Ether-soluble alkaloids varying from 0.51-1.10% by titration and from 0.38 to 1.10% by weight. The highest average percentage of Ether-soluble alkaloid was obtained from small yellowish leaves, whilst the lowest average was given by large leaves the former resembled Peruvian and the latter Bolivian Coca.

E. Novogranatense (Java Coca) plants give good yield. 100 plants yield 2.00 kilos of dry leaves whilst the same number of *E. Coca* yield only 0.362 kilos, but further experiments will be tried on this subject. Supplies of Coca from Java and Ceylon tend to diminish output in Peru and Bolivia.—Bulletin of the Imperial Institute.

COCAINA.

Constitutionally Cocaine is Ecgonine:—



with the hydrogen atoms in the carboxyl and hydroxyl groups replaced by a methyl and benzoyl group respectively.

For further details consult Gordon Sharp.—P.J. i./09, 184.—‘Coca and Cocaine studied historically.’—*Vide* also *ibid*, p. 356 for the synthesis of the

racemic modification corresponding—physiologically and chemically—to natural cocaine by Willstätter.

Toxicology.—Is converted into ecgonine in the organism. Methods of detection.—Y.B.P., 1902,60.

A Cocaine Salt in solution may be estimated by precipitating Cocaine periodide with decinormal Iodine.—P.J. i./01,553,602; ii./01,223,254.

PERMANGANATE TEST FOR COCAINE AND OTHER BODIES. When a drop of a Solution of Cocaine is placed on a dried film formed by a Solution of Potassium Permanganate on a micro slide and examined under the microscope, oily drops are seen. If however the Cocaine is dissolved in a Saturated Solution of Alum, crystals of Cocaine Permanganate will be quickly observed. Alypin, Tropacocaine and Scopolamine produce crystals from Aqueous Solutions. Beta-Eucaine, Stovaine, Novocain, Holocain and Nirvanin form no crystals with Permanganate. Saporetti's Bromine Test distinguishes these latter, for which *vide*.—P.J. i./11,94.

With Chromic Acid and Cobalt Nitrate Alypin behaves similar to Cocaine and Eucaine and precipitates with usual alkaloidal reagents and caustic and carbonated fixed alkali and with ammonia.—B.M.J. i./07,87.

The four alkaloids Cocaine, Truxilline $C_{18}H_{23}NO_4 = 329.289$ (previously called Cocamine or Isatropylcocaine), Cinnamyl-cocaine and Tropa-coeaine $C_8H_{14}NO.C_6H_5CO = 245.237$ are known to exist in coca leaves.

Pharmacology of Local Anæsthetics.

Eggleston & Hatcher, J1. Pharm. and Exp. Therap., Vol. XIII., 1919, found that "five, or more than five, times the minimal fatal vein dose of alypin, beta-eucaine, stovaine and tropacocaine can be injected subcutaneously in the cat without causing death, while four, or less than four, times the fatal vein doses of cocaine and holocaine similarly injected prove fatal"; further, that "the simultaneous subcutaneous injection of adrenalin with the local anæsthetics reduces the toxicity of the latter by delaying absorption rate, but this reduction is much less marked in the cases of cocaine and holocaine than with the other members of the series, and is referable to their much slower 'essential' elimination."

Purification of Crude Cocaine.

Cocaine, truxilline and cinnamyl-cocaine being ecgonine derivatives yield ecgonine, acids, and methyl alcohol on hydrolysis. This fact is of importance commercially as the amorphous residue remaining after extracting as much as possible of the crystalline cocaine can be converted into **ecgonine**, and this by treatment with benzoic anhydride and methyl alcohol can be converted synthetically into cocaine.

Although formerly care was taken in the extraction to preserve the Cocaine now-a-days manufacturers rely on the ecgonine content. After isolation in the crude the 'Cocaine' is treated so to reintroduce the methyl and benzoyl group. Process for ecgonine estimation has been devised.—Am. J1. Ph. Feb. '08, p. 74.

Cocaine volatilises at 100° C. This is of importance to recollect in analytical work.—Am. J1. Ph., Dec. 1910, p. 576.

Beta-Naphthalene Sulphonic Acid used for purifying crude Cocaine. Crude Cocaine 10 Gm. is dissolved in hot water containing 5 Gm. of the acid and the solution filtered warm. On cooling an oily resinous body deposits which becomes semi-crystalline. Ammonium Carbonate is added, then solution of Ammonia which produces a white precipitate. This is extracted with Ether and the pure Cocaine crystallises out from the Ethereal solution. The acid used may be recovered by concentrating the mother liquors and precipitating with Hydrochloric Acid.

Another method is to dissolve crude Cocaine in boiling water containing Acetic Acid. On cooling precipitate with Ammonium Carbonate yielding a resinous yellow precipitate lighter than water. The solution is filtered and solution of Ammonia added in excess. The Cocaine precipitated is crystallised from Ether.

The **ecgonine** contained in the resinous precipitate can be worked up. The residue is purified by crystallisation from Alcohol and pure Ecgonine precipitated by Sodium Carbonate. It is dissolved in Methyl Alcohol and the solution treated with anhydrous Hydrochloric Acid. Of the Methyl Ecgonine obtained 20 Gm. is heated on a water bath with Benzoyl Chloride 20 Gm. until no more Hydrochloric Acid is evolved. The solution is added to cold water. Benzoic Acid is precipitated. This is filtered out and the

filtrate concentrated. The Synthetic Cocaine (termed **Coca-Ethylene** in the German Patent 47,713) is then precipitated from the filtrate by means of ammonia.—De Rosemont, *Jl. Suisse de Pharm.*, Apl. 29/20, abst. C.D. '20, 934.

Cocainæ Hydrochloridum.

It should not only be in good crystals, but should, by the following modification of **Maciagan's Test**, yield a distinctly crystalline precipitate of pure Cocaine within three minutes—when 1 grain of it is dissolved in 2 ounces of distilled water, and six to eight drops of solution of ammonia, B.P., are added and well stirred. If more than 4% of amorphous alkaloid (principally Truxilline) be present, there will be only a cloudiness. The precipitate re-dissolves after twenty-four hours or more, the Cocaine being converted into methyl alcohol and benzoyl-ecgonine. Truxilline is highly toxic. (Fr. Cx. also gives this test and states the same. P.G.V gives it slightly modified.)

Can Cocaine Hydrochloride Solutions be sterilised by boiling with impunity?

Statements to the effect that Cocaine would be decomposed in solution on boiling probably depend on the slight alkalinity of the glass. A temperature of 100° C. on the water-bath in glass vessels causes only the barest trace of decomposition.—P.J. ii./09, 36; ii./09, 124.

With a view of settling the question, we provided S. Stephenson with 2 solutions 2% strength, one boiled with the Cocaine in, and made up to strength again, and the other made with ordinary aseptic precautions, but not boiled with the Cocaine in it. He reports:—"These solutions labelled simply 'A' and 'B,' without any further indication were tried on 10 eyes belonging to 5 persons. I could make out no difference as regards powers of producing local anaesthesia of conjunctiva and cornea between them. I am decidedly of opinion that such boiling as is sufficient for sterilisation does not impair the anæsthetic action."

Surgeons may therefore use sterilised solutions with perfect safety.

Cocaine Hydrochloride is sterilisable at 115° C. for 15 to 20 minutes in the autoclave. A useful list of various temperatures for drugs.—P.J. i./19, 34.

Spinal Anaesthesia with Stovaine.

Examination of urine and liquor cerebri for Stovaine eliminated. Barker describes extraction method with Ether and testing the Hydrochloric Acid solution of the base with dilute Iodine Solution,—the brick-red precipitate is indicated with so small a quantity as 1 in 150,000. *N.B.*—It is important to drive off the Ether from the Hydrochloric Acid Solution, otherwise precipitate will be given whether Stovaine is there or not. Liquor Iodi is more delicate than Mayer's Reagent.

The investigation showed that long after the analgesic effect of Stovaine (1 to 2 hours) had subsided, the base of Stovaine remains in the cerebro-spinal fluid—even for 24 hours. Stovaine (Hydrochloride) is apparently the anæsthetic substance, which is split up by the alkaline fluid.—B.M.J. ii./09, 789, *et seq.*

Novocain, Identification.—To a 0.2% solution add 2 drops of 10% Sodium Nitrite and 3 drops Sulphuric Acid and heat; then dilute with water and treat with Millon's Reagent. Red colour—identifies the Phenolic Nucleus. The Ethyl is identified by the formation of Iodoform and the Aldehyde by distilling the substance with dilute Sulphuric Acid and Manganese Dioxide and testing the filtrate with Magenta—Sulphurous Acid reagent. Bromine gives a yellow precipitate with Novocain Solution which dissolves on warming.—Y.B.P., 1919, 24.

COLCHICUM.

The corms are usually weaker in alkaloid than the seeds; about 0.3 to 0.8% s found in both.

Historical study. Colchicum is derived from Colchis, a district in Asia Minor.—P.J. ii./09, 5.

Acetic Acid is nearly equal to Proof Spirit to extract Corm and Seed.—P.J. ii./09, 142.

Farr and Wright devised a process employing Iodine as precipitant, shaking out after with Chloroform in presence of Sulphuric Acid.—P.J. ii./10, 579.

Glucose surrounds Colchicum Seed to upwards of 5 or 6% and may cause variation in yield of extractive from Tincture as it is least in dry seasons.—J. C. Umney, P.J. ii./15,393.

CONIUM.

The amount of alkaloid found in the root, stem, and leaves is small, while in the fruit it is considerable during the period when the fruit is forming its reserve material, reaching as much as 3 per cent. or even more. When the fruit has finished forming its reserve and ripens the proportion of alkaloid is found to become less, not greater, until it falls to less than 1 per cent. in the ripe fruit. Moreover, the proportion of alkaloid to total nitrogen gradually diminishes as the fruit develops. If the alkaloid were a by-product as viewed by Pictet in the production of protein it might be expected to retain a fairly constant ratio, and not become a diminishing one.—E. H. Farr, Pres. Add. B.P. Conf., 1914, P.J. ii./14,117.

The **U.S. VIII. Assay Method** is not at all satisfactory. The ammonium sulphate formed in the process does not separate completely, and the neutralisation with sodium carbonate requires great care. The method given in the 1901 "B.P.C. Formulary" is more satisfactory. (Conium is no longer official in the U.S.P.)

Characters and Color-Reactions of Conine, Conhydrine, Pseudoconhydrine, Coniceine, and a new Conine isomer.

Conhydrine stated to have an odour resembling the urine of mice. It is crystalline—either in plates like cholesterol, or in needles.

Pseudoconhydrine is isomeric with *Conhydrine*.

Coniceine is optically inactive. The Hydrochloride is hygroscopic.

There is no 'dry' reaction characteristic of Conine.—P.J. ii./09,34.

Reactions of Conine alkaloids in solution.—P.J. ii./09,70, *et seq.*

A scheme for differentiating Conine, Nicotine, Lobeline, Sparteine, the Conhydrines, Coniceine, and a new isomer is given.—P.J. ii./09,103; see also P.J. ii./05,333.

CREOSOTUM.

(P) Creosote. According to FR. CX. consists of about half its bulk Creosol, the other half consisting of Guaiacol with some cresylols, phlorol, or ortho-ethylphenol, etc. Easily soluble in alcohol, ether, anhydrous, glycerin, chloroform, also in caustic potash and soda solutions, and in acetic acid (glacial). It distils between 200 and 220° C. U.S. (Revised) now omits glycerin test.

Off. and P.G.V.—Sp. Gr. not below 1.080. Distils between 200 and 220° C.

Genuine Beechwood Creosote yielded 39% Monophenols, 26.48% Guaiacol, 32.14% Creosol $C_6H_3CH_3.OCH_3.OH$ and homologues, Pinewood Creosote about the same but 20.3% Guaiacol and 37.5% Creosol and homologues—all boiling between 200 and 210° C.—Am. Jl. Ph. 1899, pp. 409-413.

Allen, 4th Edn., Vol. III., p. 353, gives results of his own investigation and that of others in tabular form. The composition of Creosote varies considerably.

It is dextrorotatory.—*Off.* (not *laevo* B.P., 1898), or is inactive (Umney).

Guaiacol.—The Sp. Gr. is nearer 1.143 than 1.16 to 1.20 as given in B.P.—J. Cofman-Nicoresti, P.J. i./20,26.

CUPRUM.

For purifying water, Kraemer found that strips of copper foil placed in water containing colon and typhoid bacilli completely destroyed same in less than four hours. Considered a safe domestic method. A piece of copper foil $3\frac{1}{2}$ inches square in a quart of water six hours or so is all that is necessary.

He also gives a table of figures showing the amount of copper normally present in a number of substances in mgr. per kilo:—Belladonna contained 4,200, Henbane 3,600.—Am. Jl. Ph., June '05,274.

A sample of milk in which copper was present to the extent of 1 in 2,000,000 kept longer than usual. Experiments showed that small quantities of copper salts prevent putrefaction in egg and blood albumen, meat and other nitrogenous substances.—P.J. ii./10,392.

The lobster contains 0.002% metallic copper in the whole body.—P.J. i./11,405.

Chemical relationships of the **copper fungicides**.—Nature, Mar 3, 1919 p 13.

DIGITALIS FOLIA.

Preservation.—The dried leaves are best preserved in small containers over a layer of lime,—the freshly burnt quicklime being in a wide mouth bottle tied over with a layer of gauze.—*c.f.*, E. M. Holmes, P.J. i./11,164, and P.G.V., also Am. Jl. Ph., May, 1912, 201, *et seq.*

The freshly powdered leaf is favoured by many practitioners as the best method of giving the drug.

F. Norsk advises leaves of the indigenous wild-growing flowering plant dried for five hours at about 80° C., filled into well-closed containers of not more than 50 Gm. The same rule applies to powdered *Digitalis*.

Deterioration of Preparations of *Digitalis* we deal with under ASSAY.

Cultivation.

Tschirch pointed out that nothing was known as to the influence of the composition of the soil, of shade or light, of moisture or lack of moisture on the formation of Digitoxin in the plant.—P.J. ii./09,420.

Hale has disposed of the idea which has been promulgated that the leaves of wild plants are more potent than cultivated ones. Nevertheless some of the former, he says, are more potent than the latter but cultivation *per se* has nothing to do with the fact.—P.J. i./11,578.

Our own investigations have indicated that there is much to be learnt as to the ideal conditions for growth of *Digitalis*. Speaking generally, the author is of the opinion that a **dry season favours potency**. The most potent leaves in an extensive series that we have examined (both chemically and physiologically) were second year's leaves from plants grown in England in a sunny exposed situation. These leaves were from plants showing no flower spikes at time of collection. (NOTE.—*All second year's plants do not necessarily flower*. We lay more stress on the sunny situation than the point of non-flowering at the time.) See also Symes.—Footnote, p. 65.

Holmes, P.J., ii./05, p. 5, thought that *Digitalis* prefers a moderate amount of sun. Other workers in the past have expressed similar views. Ransom and Henderson found sunlight to influence the alkaloidal content of *Belladonna* (*q.v.*) which resembles *Digitalis* in nature in being a plant growing in semi-shade.

J. Bowmann (Schweiz Woch. Chem. u. Pharm., 1913, 51, 117, determined that the yield of active principles from this (as also from Aconite, Belladonna, etc.), is proportional to fluctuations in temperature.—From the years 1907-1911 the lowest yield was the cold year 1909, and highest in the **warm** year 1911.

Details of experimental cultivation at Minnesota University. The petioles and midribs contain less of the active principles than the lamina—they can be removed by sifting. Moisture determinations of first year's leaves showed 85%. A review of literature to that date.—Am. Jl. Ph., May, 1912, 201, *et seq.*

It is held that **botanical** differences between *Digitalis* plants will account in part, at least, for differences of opinion as to first and second year's leaves and fresh and dry leaves. Importance of employing selected *heavy* seed for cultivation.—P.J. ii./12,368.

Imported Digitalis is far inferior to carefully prepared British leaves. Much rain and want of sunshine have a very adverse effect on the potency of this drug.—E. M. Holmes, P.J. i./15,5.

In New Zealand *Digitalis* has become a noxious weed, as also *Hypericum Perforatum*.—P.J. i./20,522.

First or Second Year's Leaves the best?

There is a good deal of divergence of opinion on this subject.

Physiological tests have determined second year's leaves to be somewhat stronger than the first—*i.e.* in proportion of 10 to 8½. The difference is probably due to the excess of petiole in the first year's growth which it may be noted in P.L. was ordered to be removed.—P.J. i./07,198, *vide* also Am. Jl. Ph., July/08,330.

Hale, on the other hand, states that he has found the first year leaves are from 28 to 40% more active than the best second year leaves procurable. The real cause of the variation in the potency of *digitalis* leaves seems to be connected with the nature of the soil and the character of the season, etc.—P.J. i./11,578.

Focke states that second year's leaves have their highest value at time of flowering and the first year's leaves attached to them the highest value in late summer.

Our own opinion is that there is probably little to choose between the activity of first and second year's leaves. The character of the *season* has much to do with the activity—a *dry season will produce less yield of herb than a wet one, but an increased proportion of active glucosides*:

A good practical paper on *Digitalis*:—First year's leaves are intensely bitter and a good Tincture can be made from them if collected in dry season and carefully dried. Further, though the B.P. directs to be collected at time of flowering, *i.e.*, in June or July (second year's growth), it was found that a good Tincture could be made from leaves collected as late as end of September.—P.J. i./11,102. See also several references on the same subject in 'Digitalis Assay' by the author, p. 20, *et seq.*

D. gloxineiflora a horticultural gloxinia-like strain of *D. purpurea* provides leaves approximating the latter in potency. Leaves collected from wild plants in the first year may be nearly or quite as active as second year leaves.—F. A. Miller and W. F. Baker, Int. Cong. N.Y., 1912, per C.D. ii./12,482.

The first year's leaves (U.S.) show a higher percentage of glucosides than required by the U.S.P., hence should be admitted into that Pharmacopœia.—Am. Jl. Ph., Dec., 1912.

Content of Active Constituents.—

Gordon Sharp and F. W. Branson found that leaves gathered in November are as active as those gathered in August, and that leaves from plants that had flowered are equally as toxic as those from plants that had not yet flowered.—P.J. ii./12,131. See also B.M.J. ii./14,952.

The content in the leaf of Digitoxin is about 0.1 to 0.4%. It is most abundant in the leaves in August; hot dry weather increasing the content.—N.S.D.

First year's leaves in U.S.A. contained 0.3%.—Am. Jl. Ph., Dec., 1912.

The average therapeutic dose of Digitoxin may be regarded as 0.5 mgr., corresponding to the effects of 0.06 Gm. of *Digitalis* leaves—but this quantity of leaf would contain only 0.12 mgr., so there is a discrepancy of about 400%. Digitoxin therefore represents only about $\frac{1}{4}$ the power of *Digitalis*. To assay *Digitalis* by Digitoxin alone would be about as rational as to assay Opium by Codeine content.—Am. Jl. Ph., Mar., 1908, p. 108.

'**Digitalic Acid.**'—Regarded as the mother source of the Glucosides Details of manufacture.—T. Stephenson, P.J. i./14,165,187.

The Leaf Margin (epodermis and endodermis) give the strongest micro-chemical reaction for glucoside content, the base of the petiole only a very faint one.—P.J. i./19,412.

Tincture of Digitalis.—'Abel Scholar' has an interesting note on this subject (C.D. Aug. 19, '16). He finds that cold water extracts most of the soluble constituents of those removed by the official alcohol strength. The figures are as follows: 100 Cc. of B.P. tincture was evaporated to dryness, yielding 2.75 Gm. of residue. This was treated with 500 Cc. of cold water, and 250 Cc. evaporated to dryness when 1.3 Gm. remained, showing that $2.75 - 2.6 = 0.15$ Gm. of substance had not dissolved. One can appreciate the mild 'tilt' to the effect that this 0.15 Gm. was perhaps digitoxin or some constituent yet unidentified. *In vili corpore*, however, it did not cause any deviation from habitual serenity. Judex C.D. ii./16,937, replies supporting the increase in alcohol strength now adopted (*Off.*) and says that increased extractive yield does not necessarily mean increased activity.

Personally we believe that water (even cold) would yield an active preparation and that it would no doubt be possible to produce an active aqueous preparation with adequate preservative added.

Pandigiton—

Acetone extracts the whole of the active principles of *Digitalis*. An extract of this kind called *pandigotin* it was found had M.L.D. 1.2 mgr. per Gm. weight of frog.—A. Tschirch, Schweiz., Ap. Zeit. Y.B.P. 1919,84.

Characters and Tests of Glucosides.

The determination of the value of a *Digitalis* preparation (especially the Tincture) by chemical means is fraught with considerable difficulties owing to many factors, *e.g.*, the numerous glucosidal bodies contained, the fact that it is not possible to point to one glucoside as the potent constituent as repre-

senting the activity of the drug; and again the extraction of the substances in any degree of purity requires some analytical skill.

We adopted as our standard a Tincture having by physiological tests a M.L.D. calculated as 0.75 Cc. per 100 Gm. weight of frog.

In a paper read before the Pharmaceutical Society of Great Britain, Dec. 10/1912, the results of examination were provided of some two dozen samples of leaves both of the author's growing and from sources in various parts of the world (Great Britain, Germany, Italy, India, etc.). Almost all of these leaves gave tinctures of Standard or above Standard strength.—P.J. ii./12,745,758,778; L. ii./12,1740; B.M.J. i./13,28. The paper was published in booklet form entitled 'Digitalis Assay.'

The glucosidal bodies with which we are concerned are:—

From Digitalis Leaves.

Digitoxin the most potent glucoside present.

GITALIN which is the name given by **Kraft** to DIGITALEIN of Schmiedeberg and Kiliani in a purified form.

DIGITONIN AMORPH. *Syn.* DIGITSAPONIN, Kraft

GITIN.—A further Saponin

The last two are relatively inactive.

E. Berry in a communication on the active principles of Digitalis (P.J. ii./15,783) mentions as further constituents of the leaves: An irritating fat or resin soluble in ether, a fluorescent body **LUTEOLIN** or **DIGITOFILAVONE** and an active enzyme or oxidase.

From Digitalis Seeds.

Digitalin. (*Syn.* Digitalinum. Verum).

GITALIN. Common to leaves and seeds *vide antea*.

DIGITONIN AMORPH. (Schmiedeberg) and **DIGITONIN CRYST.** of Kiliani.

In 'DIGITALIS ASSAY' we give a full account of the body **Gitalin**. The glucoside is to a great extent of academic interest rather than practical importance. The yield of it is stated to be about 0.07%.

Focke reported on his experiments with **gitalin**, which is said to be present in what was considered as pure **digitoxin** to the extent of four-fifths, and he concludes from his experiments that a solution of **gitalin** could well serve as a standard for physiological assay.—C.D., Oct. ii./13, from "Zeitschrift für Experimentelle Pathologie und Therapie."

Digitoxin Recognition Tests.

Keller-Kiliani (*Syn.* **Keller's Test**) for **Digitoxin** in the Leaves.—Shake 10 Cc. of filtered infusion in boiling water 1+20 in a separator for a few minutes with chloroform 10 Cc., add ether 5 Cc. and alcohol 5 Cc.; shake again and filter off the chloroform-ether solution through a filter moistened with chloroform. The liquid is evaporated and the residue dissolved in 3 Cc. of acetic acid (96%). A drop of diluted solution of ferric chloride (1+19) is added, and the whole, in a narrow test-tube, is layered carefully upon sulphuric acid; at the point of contact of the two liquids a brownish-red zone develops, and over it a bluish-green zone.—P.G.V. We find in practice the presence of Chlorophyll hinders the coloration considerably.

The test may also be applied to the glucosidal substance **Digitoxin** thus:—Dissolve 0.001 Gm. in 3 Cc. Glacial Acetic Acid, add a few drops of the Ferric Chloride Solution and proceed exactly as the rest of the last mentioned.

Fröhde's Test (**Sulphuric Ammonium Molybdate** *vide* Colorimetric Method *infra*) Ammonium Molybdate 1% w/v. in concentrated Sulphuric Acid used as a *mixing* test gives characteristic maroon colour with the water soluble glucosides—see colour scale. Used as a layering test, it gives a characteristic blue ring.

Kiliani Test for Digitalin.

Ferric Sulphate 0.05 Gm. is dissolved in water 1 Cc., and Sulphuric Acid added to 100 Cc. Employed as a mixing test (0.1 mgr. of the glucoside is sufficient, dissolved in 0.2 Cc. of Glacial Acetic Acid), this reagent produces a pink coloration.

This test with **Digitoxin** produces a brownish colour—if pure a decided brown

Digitalis Assay.

Chemical Assay processes have been devised by many workers in the past. In this connection the names of Keller, Fromme, Stoeder, Gordon Sharp, Barger and Shaw, Barenstein and Burmann should be mentioned.

These methods were almost entirely centred on an estimation of the **Digitoxin** content—*whilst ignoring the bodies which are known to be readily soluble in water*. That this was fallacious was shown by Ziegenbein, who found that leaves containing only 0.125% of this glucoside were twice as active as those containing 0.226%.

Our aim was to produce a method which shall include these latter important substances in addition to Digitoxin or a closely allied body. The process devised effects this adequately and, it may be added, includes a strong indication of Digitoxin—either by reason of the actual solubility of this body in the repeated quantities of solvent prescribed (the amount of Digitoxin in 10 Cc of Tincture is obviously extremely minute though sufficient to detect with the delicate reagent) or owing to the fact that Digitoxin is soluble in the presence of the other accompanying Glucosides, Saponins and decomposition products. The process does not claim to necessarily extract *all* the Digitoxin though *practically none can be found in the residues* in the various steps.

By means of this test (*see colored plate opp. p. 63*) results closely approximating the physiological "M.L.D." results were obtained with the samples of Tinctures referred to.

The conclusions of the investigations were as follows:—

(1) Digitalis preparations can be assayed by a simple colorimetric method.
(2) The process shows whether a tincture is *above* or *below standard*, and it will with certainty show an excessively strong or a weak preparation. The method uses only a small amount of tincture. The apparatus and reagents are perfectly simple, and such as a pharmacist would have at hand.

(3) There are strong indications that digitoxin is not entirely insoluble in water.

(4) The pharmacist can conduct the process himself and be independent of pharmacological experiment.

(5) Selected leaves recently dried, as a general rule, will produce tinctures up to standard, but there is obvious danger in the variation which may occur. At present a patient might easily obtain a preparation twice as strong at one pharmacy as at another. Considering the fact that, with digitalis, prolonged administration in the treatment of heart affections is almost always necessary, and that the initial doses of digitalis are invariably large, it is evident that standardisation of its preparations is of great importance.

(6) Tinctures of commerce vary considerably.

In the original paper the author admitted that a tincture becoming weak physiologically *might* possibly still give the same colour test as originally. To settle this question a supply of **a tincture twelve years old** was examined by the process at the end of 1912, using a strong tincture "J" (*c.f.* Table) and a weak tincture of commerce as controls. This old tincture gave a colour reaction almost equal to "J." The three tinctures in question (under distinguishing marks) were simultaneously examined by a physiologist,—the combined results being as follows:—

	Dose per 100 Gm. frog.		W. H. Martindale's Colour Scale.
	Killed (M.L.D.)	Failed to Kill.	
Tincture "J"	0.6 Cc.	0.5 Cc.	Strong = 3.
Tincture 12 years old	0.7 Cc.	0.6 Cc.	Strong = 2 to 3
Weak Tincture of Commerce	0.9 Cc.	0.8 Cc.	Below Stand'd.

These results showed **the value of the process even with an exceedingly old tincture**—the fact that a tincture 12 years old should show activity at all would have been generally discredited.—L.i./13,77.

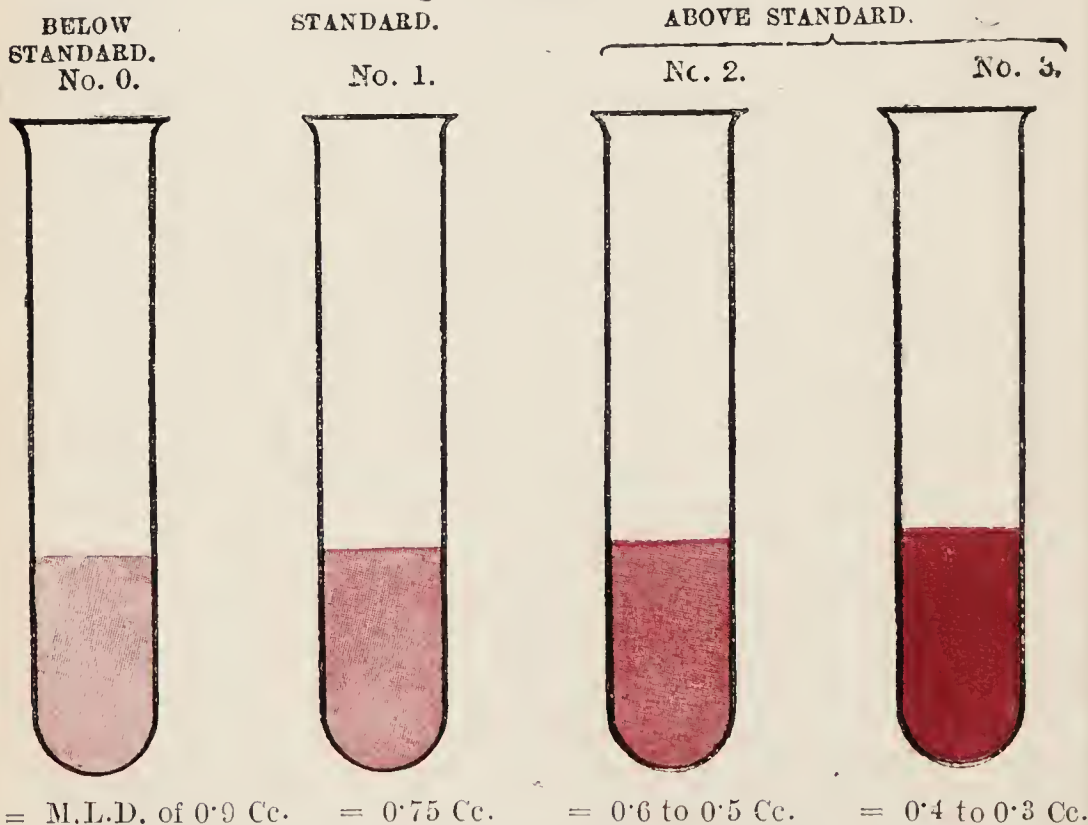
Subsequent to this it was decided to store the entire series of Tinctures for one year and re-examine both chemically and physiologically. This provided useful information (1) on the utility of the Test; (2) as to the generally acknowledged diminution in strength of Digitalis Tinctures.



The **Colorimetric Method** devised gives results equivalent to the Physiological Assay Method based on the minimum lethal dose required to kill a frog and calculated to 100 Gm. body weight. The method requires some care in carrying out, as it is strictly quantitative. It is as follows :—

To determine whether a Tincture is up to Physiological Test requirements (usually taken at M.L.D. = 0.75 Cc. per 100 Gm. body weight of frog) mix 10 Cc. of the Tincture with 10 Cc. of water, precipitate with 10% Neutral Lead Acetate Solution (about 3 Cc.), adding a little Kieselguhr. Allow to stand for a $\frac{1}{4}$ hour, filter off on the pump, wash the precipitate slightly. Remove excess of lead from the filtrate with 10% Sodium Phosphate Solution (about 2 Cc. required) and filter. Add a little Calcium Carbonate (about 0.2 Gm.) to the filtrate (to prevent possible hydrolysis of the glucosides), and evaporate to dryness on a water-bath. Add about 2 Gm. of dry washed sand to the residue and extract with Chloroform five times by thorough trituration using about 10 Cc. on each occasion. Filter and evaporate the Chloroformic Solution and extract the residue with warm water on the water-bath, using 10 Cc. and 5 Cc. and again employing sand. Filter, evaporate to dryness in a porcelain basin, extract the residue again with cold Chloroform to purify it (about three or four quantities of 5 Cc. each using dry sand and triturating thoroughly with a small pestle) and filter. Evaporate the combined Chloroformic Liquors and dissolve the residue in 4 Cc. of Glacial Acetic Acid. Mix 0.1 Cc. of this Acetic Solution with 1 Cc. of Sulphuric Ammonium Molybdate Reagent in a 5 × 1 Cm. test tube and compare the depth of colour after five minutes with the scale below—this coloration indicates the *content of combined "active water soluble" Glucosides* (probably including Digitoxin). Further, if 0.1 Cc. of the Acetic Solution be mixed with 0.5 Cc. of Glacial Acetic Acid, and this be layered upon 1 Cc. of the Sulphuric Ammonium Molybdate Reagent, the typical blue ring showing presence of Digitoxin should be formed.

SCALE.



Mount the tubes on a little slab of Plasticine and observe the colours by direct transmitted light using a white background.

The results obtained are given in the following table:—

Results of a Comparison of Physiological and Chemical Standardisation of Digitalis Tinctures in Oct.—Nov., 1912, and after 12 months' storage, i.e., Oct.—Nov., 1913.

Ori- ginal M'rks.	1912.		1913. Stored by Author.		1913. Stored by Physiologist.	
	Colour and M.L.D. = Cc. per 100 Gm. frog.	Phys. M.L.D. =Cc. per 100 Gm. frog.	Colour and M.L.D. Marks known by Author.	Phys. M.L.D. = Cc. per 100 Gm. frog. Marks unknown by Phy- siologist.	Colour and M.L.D. Marks unknown by Author.	Phys. M.L.D. Marks known by Phy- siologist.
	1.	2.	3.	4.	5.	6.
A. ..	—	0.5	—	—	—	—
B. {	No. 2. 0.5 to 0.6	0.4 to 0.6	No. 2. 0.5 to 0.6	0.6 to 0.6	No. 1 (twice). 0.75	0.8 to 1.0
C. {	No. 2-3. 0.4 to 0.5	0.4 to 0.5	No. 2. 0.5 to 0.6	0.8 to 1.0	No. 1. 0.7	1.0 to 1.2
D. {	No. 2. 0.5 to 0.6	0.5 to 0.6	—	—	—	0.6 to 0.8
E. {	No. 1-2. 0.6 to 0.7	0.6 to 0.7	—	—	—	1.0 to 1.0
F. {	No. 2. 0.5 to 0.6	0.5 to 0.6	No. 1. 0.75	1.0 to 1.2	No. 1-2 (twice). 0.65	0.8 to 1.0
G. {	No. 2. 0.5 to 0.6	—	No. 1. 0.75	1.0 to 1.2	—	—
H. {	No. 2. 0.5 to 0.6	0.5 to 0.6	No. 2. 0.5 to 0.6	1.0 to 1.2	—	0.8 to 1.0
I. {	No. 2-3. 0.4 to 0.5	0.4 to 0.5	No. 1. 0.75	1.0 to 1.2	No. 1-2. 0.65	1.0 to 1.2
J. {	No. 3. 0.3 to 0.4	1st. 0.3 to 0.4 2nd. 0.5 to 0.6	No. 3. 0.3 to 0.4	0.8 to 0.8	No. 1-2 (twice). 0.65	0.7 to 0.8
K. {	—	—	—	—	—	—
K. {	No. 1. 0.75	0.6 to 0.75	No. 1-2. 0.6 to 0.75	1.0 to 1.2	No. 2. 0.65	1.1 to 1.2
L. {	Below Standard 0.9	0.3 to 0.4	Much below Std.	0.6 to 0.8	—	0.8 to 1.0

The blanks indicate lack of material

Storage Experiments.—Continued.

Original M'arks.	1912.		1913 Stored by Author.		1913. Stored by Physiologist	
	Colour and M.L.D. = Cc. per 100 Gm. frog.	Phys. M.L.D. =Cc. per 100 Gm. frog.	Colour and M.L.D. Marks known by Author.	Phys. M.L.D. = Cc. per 100 Gm. frog. Marks unknown by Phy- siologist.	Colour and M.L.D. Marks unknown by Author.	Phys. M.L.D. Marks known by Phy- siologist.
	1.	2.	3.	4.	5.	6.
M. {	No. 2. 0.5 to 0.6	1st. 0.8 to 0.81	No. 2. 0.5 to 0.6	1.0 to 1.2	No. 2. 0.6	1st. 1.0 to 1.2
N. {	—	2nd. 0.5 to 0.6	—	—	—	2nd. 0.9 to 1.0
O {	—	—	No. 2. 0.5 to 0.6	0.6 to 0.6	—	—
P. {	No. 2. 0.5 to 0.6	0.57 to 0.6	No. 1-2. 0.6 to 0.75	1.2 to 1.4	No. 1. (twice). 0.75	1.2 to 1.3
Q {	Below Standard. 0.9	0.8 to 0.9	No. 1-2. 0.6 to 0.75	1.2 to 1.2	Below Standard 0.9	1.4 to 1.4
R {	No. 3. 0.3 to 0.4	0.36 to 0.4	0.75	0.6 to 0.8	—	0.6 to 0.8
S {	No. 2. 0.5 to 0.6	—	No. 2-3. 0.4 to 0.5	0.8 to 1.0	—	—
T. {	No. 2. 0.5 to 0.6	—	No. 1-2 0.6 to 0.70	0.6 to 0.8	—	—
U {	No. 2-3. 0.4 to 0.5	0.4 to 0.5	No. 2-3. 0.4 to 0.5	0.8 to 1.0	No. 2-3. 0.5	1.0 to 1.2
V {	—	0.2 to 0.3	No. 1-2. 0.6 to 0.7	0.6 to 0.8	No. 1 0.75	0.6 to 0.8
W. {	—	—	No. 2. 0.5 to 0.6	—	No. 1-2. 0.65	0.9 to 1.0
X. {	No. 2-3. 0.4 to 0.5	0.6 to 0.7	No. 3. 0.3 to 0.4	0.6 to 0.8	—	0.9 to 0.9

Comparing the Chemical (Colour Scale) Results in columns 1, 3 and 5, it will be seen that we show a distinct falling off in strength after keeping one year in practically all the Tinctures.

Our physiologist's results (columns 2, 4 and 6) are similar. He shows falling off in all the Tinctures. His results indicate a more marked general diminution in strength than the colour figures.* (NOTE.—Other workers have found a Tincture to decrease in strength by physiological test about 10% only in a year. Many workers in the past have stated that Digitalis Tincture is not so unstable as is supposed. Haynes, as also Hatcher and Eggleston, showed that the diminution in strength is quite small.—*Vide* Vol. I., p. 388.

* See footnote on page 65

There are clearly some discrepancies both in the chemical and the physiological results which are attributable to methods of storage and the laborious nature of the investigation. So far as the physiological data are concerned, these were all obtained upon Tinctures *undiluted*, whilst the Colour Scale data (col. 5) were in several instances obtained with Tinctures which had been diluted without our knowledge (1 to 10, 1 to 20, etc.) as our physiologist had run short of material to send back to us. Even this did not "trip up" the quantitative delicacy of the Colour Test, though the amounts of glucosides under investigation are exceedingly minute.

It will be seen that comparing columns 3 and 5 (in the one case knowing the marks and in the other not knowing them) the results are remarkably concordant. Owing to lack of material, our physiologist, again without our knowledge, *duplicated* several samples (A, F, J, O), and in these we obtained identical results on each occasion.

With regard to the fact that the physiological results show a more marked falling off in strength than our colours indicate, there is, of course, the well-known "frog variation" to consider. The frogs in the re-examination in 1913 were probably of a more vigorous strain than those used in 1912. It was hardly to be expected that a tincture 'W' found to be active physiologically after 12 years (M.L.D. 0.6 to 0.7 Cc.), should during the *next year* drop off, making M.L.D. 0.6 to 0.8 or 0.9.

To act as a check on the physiological results, we handed over to the physiologist in the middle of November, 1913, under marks "I" and "II" the following with a request for a final report:—

I. The 12 (then 13-year) old Tincture diluted to half strength* with 60% Alcohol.

II. Tincture "N." These two were selected as respectively tinctures upon which we differed and agreed in the October, 1913, examinations.

The position was at that time (Oct., 1913), as follows:—

	Mark not known by Phys.	Mark known by Phys.
The 12-year-old Tincture (W) = { Colour No. 3.		
	0.3 to 0.4 Cc.	0.6 to 0.8 Cc.
Tincture (N) =	0.5 to 0.6 Cc.	0.6 Cc.
The new report was No. I. =	1.0 M.L.D. and No. II. =	0.6, i.e., —

$$\text{Tincture (W)} = \frac{1.0}{2} = 0.5 \text{ Cc. as M.L.D.}$$

$$\text{Tincture (N)} = 0.6 \text{ Cc. as M.L.D.}$$

* W. L. Symes, in an investigation on the activity and stability of digitalis tinctures, found that: (1) weak ones showed little or no change in a year or more; (2) those within 25% of standard were all more than 25% below standard after a year; (3) of those more than 25% above standard, only half were within 25% of standard after one year, these having lost 20 to 70% of their original activity. He found that of the tinctures he examined 20% had an initial activity of 0.6 to 1.0 (activity = $\frac{\text{Standard M.L.D.}}{\text{Observed M.L.D.}}$ =

$\frac{0.75}{x}$) 22%, 1.1 to 1.25; 33% 1.4 to 1.7; 25% 1.9 to 2.5.—B.M.J. i./14, 1343;

—W. H. Martindale in reply.—B.M.J. ii./14, 47.

W. L. Symes, P.J. ii./14, Aug. 1, has a further paper on this subject. In conjunction with Messrs. Stafford, Allen and Sons, he deals with the effects of climate on the plant. The weather factor, he says, may influence metabolism of the living plant. We fully agree that the plants "may 'yield' better in partial shade"—i.e., *weight* of leaf, but this does not entail extra yield of glucosides and even Dr. Symes' own table (III. intending to upset our theory, that the most potent leaf (2nd year's) is collected after a *period of bright sunshine*,—in reality supports our view. e.g., the 1910-1911 leaf, the most active of the three, though growing in "Moist dull variable warm" weather in 1910 was collected in 1911 after "dry bright hot weather."

The number of hours of sunshine in 1911 in the 2nd and 3rd quarters, viz., 45, yielded him an 'activity' 2.1, whilst the next year, 164 hours, yielded activity 1.3 to 1.4. N.B.—Do not confuse this new 'activity' with M.L.D.'s:

So that we see here in the case of "W" a considerable anomaly,—what may be termed an *increase* in strength to almost double in about 6 weeks whilst in the case of "N" there is an exact accordance in strength.

It is only fair to say that the supply of the 12-year-old Tincture was small—this prevented a repetition of the physiological test—reliance had to be placed on one experiment.

We offer these criticisms as an argument in favour of the colorimetric chemical method, whilst at the same time admitting that the physiological results were otherwise most concordant.

Clearly **the colour reactions are produced by the glucosides and do not depend on decomposition products**, as if due to the latter we should have shown a *uniform increase in strength* in columns 3 and 5, whilst on the contrary there is a general decrease as compared with column 1.

1920 EXPERIMENTS.—We have quite recently again compared results by our chemical method with those obtained by our physiologist.

The results were as follows :—

	CHEMICAL FINDINGS, M.L.D.	FROG EXPTS., M.L.D.
A Tincture made from average quality 1920 leaves grown by the author.	No. 2 (= 0.6 to 0.5 Cc.)	0.65 Cc.
A Liquid Extract 10 × B.P. strength diluted to B.P. strength.	Between No. 1 and No. 2 (= 0.61 Cc.)	0.62 Cc.

In conclusion, we hold, and *have proved*, that the test gives concordant results.

D. Purpurea grown in the Nilgiris, Madras, India, was found well up to standard both by W. H. Martindale's Colour Test and Physiological Tests.—Gordon Sharp, P.J. ii./17,108.

E. Berry has extended the author's process for estimation of *Digitalis* leaves and employing similar reagents estimates (A) the content of water-soluble glucosides only, (B) the content of total glucosides. In the latter Alcohol of 70% strength is maintained throughout to keep all the glucosides in solution. The result of (A) is called the Therapeutic Value.—B.P. Conf., 1919.

Tschirch confirms Ziegenbein that the Digitoxin content in *Digitalis* leaves is not in proportion to the physiological activity. It was found that *Chloroform must be used repeatedly* (eight shakings) to remove the entire active substances (we have found this also : note the *repeated extraction* in our colour method). The active substances are in some form of combination which is broken up by the repeated shaking. Absolute Alcohol, **Acetone** and Amyl Alcohol will exhaust leaves completely ; Chloroform, Acetic Ether and Benzene partially. Ether and Carbon Tetrachloride do not extract the active substances at all. Acetone is specially good as yielding a colourless extractive. It can be used for assaying. (The use of Acetone instead of Chloroform in our method would no doubt yield even more interesting results.)—Schweiz, Ap. Zeit., Vol. 56, p. 469, abstr. P.J. i./19,219.

Physiological Standardisation.—

Physiological reports **by different workers** on one and the same preparation are **notoriously divergent and erroneous**. For our own part, we have found that results are better than one would anticipate, but we have *kept to one physiological*.

A. Goodall found of ~~28~~ tinctures examined (*laboratory samples, not those of commerce*), only ~~12~~ were up to the average, 6 were under : and instead of a maximum dose of 15 minims from 18 to 25 minims were necessary. Several were above strength, *e.g.*, 4 to 10 minims. End point employed was complete death in four hours. A standard preparation of Tincture *Digitalis* remains active twelve months.—B.M.J. ii./12,47,149.

Average obtained from 207 experiments:—

"A"	leaves 2 Cc. of Infusion	caused stoppage in	23 minutes.
"B"	" 3 Cc. "	" "	10 "
" "	" 2 Cc. "	" "	27 "
" "	" 3 Cc. "	" "	21 "
0.05 mgr.	of Strophanthin	caused stoppage in	32 "
0.1	" "	" "	25 "
0.15	" "	" "	15 "

2 Cc. of "A" leaves	Infusion	=	0.114 mgr. of Strophanthin.
3 Cc. "	"	=	0.171 "
2 Cc. of "B" "	"	=	0.085 "
3 Cc. " "	"	=	0.128 "

0.1 mgr. of Digitoxin caused stoppage after 27 mins.
0.2 " " " " " " " " 10 "

Compared with leaves "A" an average of 2 Cc. of Infusion = 0.128 mgr.	of Digitoxin.
" " " " "B" " " 2 Cc of Infusion = 0.095 mgr.	of Digitoxin.

That is $A : B = 134 : 100$

Frogs seem to have more power of resistance in the months of August and September. Though one may compare the pharmacological action of Digitalis with that of a chemically well-defined body, the action of Digitalis on the human organism cannot be estimated by such relationships, as this can only be effected by observations on patients. Schmiedeberg therefore proposed that all the Digitalis issued for medicinal use in Germany should first be standardised in a central Institute, and the crop of each succeeding year standardised to correspond exactly to the basis established in the first year.—L. ii./10,960.

Comparison of Physiological Standards.—The various workers on the subject—Cushny, Dixon, Houghton, Martin, etc., have from time to time set up the most divergent time limits for the death of the frog employed in the test. We went very fully into this matter in previous Editions. The U.S. IX. may be taken as a guide to current opinion.

Digitalis U.S. IX. For preparation of Tincture must be of such strength that the m.l.d. of the tincture is not greater than 0.006 Cc. or the equivalent of 0.0000005 Gm. of Ouabain for each Gm. of body weight of frog.

The same remarks apply for *SCILLA* U.S. IX. and its preparations, as for *Digitalis*.

Digitalis, Strophanthus and Squill in the new U.S.P. are assayed by determining the dose of the drug or its preparation which *will arrest the heart of a standard sized (15 to 25 Gm.) frog in systole in 1 hour's time.*

The doses should be as uniform as possible—in the neighbourhood of 0.015 Cc. for each Gm. of body weight of frog. The alcohol content should not be above 20%. Injections are made into the anterior lymph sac. At the end of an hour the frog is pithed (both brain and cord). The correct end reaction is that the ventricle is in systolic standstill while the auricles should be widely dilated.

Owing to *seasonal variation* a standard of Ouabain has to be employed and corrections made if necessary.

The standards are as follows :—

	Gm. or Cc. for each Gm. of frog.		Gm. or Cc. for each Gm. of frog.
OUABAIN	0.0000005	STROPHANTHUS—	
DIGITALIS—		Seed (in form of tincture)	0.000006
Leaves (in form of tincture)	0.0006	Tincture	0.00006.
Fluid Extract.. ..	0.0006	SQUILL—	
Tincture	0.006	Dried (in tincture form)	0.0006
		Fluid Extract	0.0006
		Tincture	0.006

Pithing frogs prior to experiment is as follows:—The brain of the animal is destroyed from the nape of the neck upwards, *i.e.*, the spinal cord is divided in the neck and then a wooden pointer is passed up into the brain (the centres of feeling), thus leaving the spinal cord intact and the heart untouched. A frog has been known to “live” for years with its brain destroyed. The animal feels nothing but its heart goes on beating and its reflex centres are alive.—Gordon Sharp, P.J. i./13,21

There is a general parallelism between physiological activity measured by response of muscle and toxic or narcotic power found by “killing power” per weight of living animal, the MUSCLE TEST method gives more precise results than the latter.

The method is applicable to physiological standardisation of Digitalis and allied preparations.—Prof. A. D. Waller. Details in last Edn., p. 58.

References to work on Physiological Standardisation.

A RÉSUMÉ OF THE VARIOUS PHYSIOLOGICAL METHODS FOR STANDARDISATION OF DIGITALIS SUGGESTED HITHERTO.—Guinea-pigs possess no advantage over frogs for experiments. Lethal dose methods are unsatisfactory. The fact that a preparation kills an animal is no proof of the therapeutic value. Frog heart methods (Focke's and the 1 hour) are not lethal dose methods, and they are accurate within 10%.—Am. Jl. Ph., '11, p. 201.

As already stated, Tschirch has elaborated a process for estimating the total glucosides **Pandigiton** in Digitalis by use of Acetone, Ether being used first to free from resins, fat, etc. (The glucosides are insoluble in Ether).—C.D. '20,1372.

Digitalis Flowers. S Hirohashi, Pharm. Soc. of Japan Journal, No. 369 (per C.D.), states the Digitalis flowers probably contain more active principles than the leaves (? W. H. M.). He found that an absolute alcohol extract of flowers fourteen months old was stronger physiologically than a similar preparation of fresh leaves. So far as the activity of the fruit is concerned, he puts it at the same as the leaves, while the leaf-stalk is not so active as the leaves.

Digitalis Seeds are said to be ten times more toxic than the leaves. Tincture suggested.—P.J. ii./11,231.

The seeds contain very little Digitoxin, which is generally considered the most valuable constituent and a relatively large amount of Digitonin which has little or no use as a cardiac tonic.—Dixon, Q. Jl. Med., Jan., '12,297.

We prepared a **Tincture of the Seeds**. Our physiologist reported as follows upon it. Tested on the excised frog's heart, it was found that after removal of the Digitonin in which it was rich, the seed preparation proved to be weaker than an ordinary Tincture. Hence as it seems to be therapeutically weaker and yet more toxic than Leaf Tincture, it does not appear to be a desirable preparation. Digitonin is considered to be irritant to the alimentary canal.

General References.

The decomposition products of the glucosides in the drug may of themselves be valuable. The best preparations of Digitalis are those made without intervention of reagents.—P.J. ii./13,573.

H. Deane finds the physiological test not always correct; for example, a fat-free tincture proved stronger than the ordinary tincture. It had been found that the autumn leaves gathered after a wet summer were about the same as the previous year's (relatively dry) crop, while leaves gathered before the wet weather were weaker in glucosides.

The ash of the leaves contains Manganese.—Burman Schweiz. Woch., 1911, 562.

Pharmacology of Digitalis.

On the one hand it exercises a direct effect on cardiac muscle, while it also heightens the vagus inhibition of the heart. By the use of Atropine it was found possible to cut out this second effect, and thus to study the direct cardiac action.—L. ii./12,1668.

TABLE OF THE COMMON ENZYMES AND FERMENTS.

ENZYME OR FERMENT	SOURCE.	ACTION.
Amylopsin or Diastase	Malt and pancreas.	Converts starch into dextrin and finally maltose, <i>c.f.</i> , Vol. I. pp. 502, 585. <i>Vide</i> also Farr p. 70.
Amylase	Human and cow's milk and in human saliva.	Hydrolyses starch as far as dextrin.—B.M.J. i./13,1067.
Calotropis Procera	Latex of.	Contains an enzyme.
Catalase (<i>see also Peroxidase</i>)	Blood and body fluids, <i>e.g.</i> , milk.	Decomposes Hydrogen Peroxide.—B.M.J. i./13,1067.
Cellulase	Grass eating animals	Converts cellulose into sugar, as in the case of graminivorous feeders.—L. i./13,470.
Chymosin, see Rennin		
Digestin	Okazaki Fungus.	Converts starch into sugar and peptonises milk, <i>c.f.</i> , p. 535.
Emulsin	Almonds.	Hydrolyses glucosides, <i>e.g.</i> , Amygdalin, <i>vide infra</i> , also Vol. I., p. 144.
Erepsin	Cauliflowers.	Acts as a tryptic ferment.—C.D. ii./13,851.
Fibrin Ferment ..	Blood.	Forms the clot when blood is shed.
Hydrogen Peroxide and Ferrous Sulphate in certain proportion	—	Liquefy starch.—C.D. ii./13, 851.
Invertase	Intestinal juice and produced by yeasts	Is capable of converting 200,000 times its own weight of cane sugar into invert sugar.—C.D. ii./13,851.
Lactase	Animal body	Converts lactose into galactose.—L. i./13,470.
Lactic Acid Ferment	Milk.	Converts lactose into Lactic Acid.
Lipase	Pancreatic juice, blood plasma and many plants.	Converts fat into fatty acids and alcohol.—L. i./13,470.
Myrosin	Mustard seeds	Hydrolyses the mustard glucoside, Vol. I., p. 694 and Vol. II., p. 144.
Oxidases	Tissues, especially Columnar Epithelium & glandular.	Oxidise purins, alcohol, aldehyde, phenol and tyrosin.—L. i./13,470.
Papain	The juice of <i>Carica Papaya</i> .	} Convert Albumin into Peptone in acid solution, pp. 621, 630.
Pepsin	Stomach, <i>e.g.</i> , Pigs.	

Enzyme Table—continued.

ENZYME OF FERMENT	SOURCE.	ACTION.
Peroxidases and Catalases	Blood and body fluids, <i>e.g.</i> , milk.	Oxidizing agents.—B.M.J. i./13, 1067. Set free Oxygen from Hydrogen Peroxide.—L. i./13, 470. The action of these bodies is analogous to that of the Colloidal metals, or they may <i>depend on</i> presence of latter.
Perhydridase ..	Ditto	Reducing agent.—B.M.J. i./13, 1067.
Ptyalin ..	Saliva of the mouth.	Converts starch into sugar.
Rennin or Chymosin	Stomach of sucking animals, <i>e.g.</i> , calf	Coagulates the casein in milk, effecting clotting.—L. i./13, 470, <i>c.f.</i> , Vol. I., p. 630.
Steapsin, Piolyn or Lipolytic Ferment	Pancreas.	Decomposes fats into glycerin and fatty acid, Vol. I., p. 617.
Thrombin ..	Blood	Coagulates fibrinogen into fibrin.—L. i./13, 470.
Trypsin ..	Pancreas.	Converts albumin into peptones in presence of dilute alkali, Vol. I., p. 617.
Urease ..	Urine, especially in catarrh of bladder,	Converts urea into Ammonium Carbonate, <i>v.</i> Urine chapter
Zymase ..	Yeast.	Converts sugars into alcohol, Vol. I., p. 273.

Coenzymes or Activators accelerate the action of enzymes, *e.g.*, *Enterokinase*, the constituent of the intestinal fluid which activates trypsin.—L. i./13, 470.

Ferments and Fermentation.—*Na.*, July, 1911, p. 4.

E. H. Farr, in his Pres. Add. B.P. Conf., 1914, gave an interesting account of enzymes of which he states 120 are known. He pointed out the methods of stabilisation that are used in France for herbs and at the same time indicated that our methods should not be hastily altered seeing that our drugs have gained repute on non-stabilised material.

In some cases several enzymes may take part in the hydrolysis of a glucoside. With the complex **emulsin**, for instance, the hydrolysis of amygdalin takes place in three stages:

1. Amygdalase resolves amygdalin into amygdalic nitrile glucoside and one molecule of glucose.

2. Beta-glucosidase hydrolyses the amygdalic nitrile glucoside into amygdalic nitrile and glucose.

3. *d*-Oxynitrilase decomposes the amygdalic nitrile into benzaldehyde and HCN.

Side chain theory in enzyme action.—E. S. Edie, B.M.J. ii./14, 506

ERGOTA.

In Vol. I. we deal fully with the active principles of Ergot, to wit, the Alkaloid Ergotoxine and the co-existing Amines to which reference is to be made.

Ergot was found to become 7 or 8 times weaker after being kept one year, whilst aqueous extracts of Ergot begin to lose activity in a few hours.

It has been suggested that Ergot might possibly be cultivated on nutrient media made from cereals such as wheat and rye.

Not only were fluid extracts physiologically active in proportion with the amount of precipitate they yielded on dilution with water, but also in proportion as this precipitate yielded high percentage of Benzol extractive. Benzol, however, does not exhaust the drug completely. The Benzol

extractive is a yellow resin, soluble also in Alcohol, insoluble in Acids, but readily soluble in solutions of the Hydroxides.—Am. Jl. Ph.—May, '09, 215.

Yield of alkaloid 0.06 to 0.12%.—P.J. ii./04,475; P.J. ii./05,580.

Samples yielding high extractive to water inferior therapeutically to ones yielding low.—Southall's Lab. Rep., 1907. Nine samples gave from 14.56 to 20.57%.—average 16.7% water-soluble *ibid.*—1912.

[P1] **Ergoxanthin**, a principle found in ergot. A brief historical summary of the discovery of the alkaloids of ergot.—Am. Jl. Ph., Sept., 1910, 410.

Ergotinine may be detected in an alcoholic solution containing one part in 1,240,000 by means of Mercury Potassium Iodide.—Wolter Chem. Zeit. 1918 abst. Ann. Rep. Chem. Soc., 1919 (Vol. XV) p. 126.

Histamine (B-iminazol-ethylamine) in large doses produces symptoms very like those of anaphylactic shock and the latter has many features in common with surgical shock. The action of Histamine as a vasodilator would seem to be on the capillaries rather than on the arteries or arterioles and the fall of pressure in surgical shock is almost certainly due to a similar capillary dilatation.—Abst. Ann. Rep. Chem. Soc. 1919 (Vol. XV.), p. 151.

Further on Histamine, see Pituitary Gland this vol.

History and Chemistry of Ergot.—Outbreaks of Ergotism in the sixteenth century in Germany (Hessen). There was little in England, probably because rye was little cultivated here. Epidemics ceased about 1770. A complete statement of the chemical constituents.—G. Barger, P.J. ii./20,470.

EUCALYPTI OLEUM.

Eucalyptol. *Syn.* Cineol, Estimation of.

The Phosphoric Acid Method may be used as *Off.* in Oleum Eucalypti. It is more accurate than the Resorcinol method—the latter gives results far too high. U.S. IX assays by converting the Eucalyptol into **Arsenate** at 0° C. The arsenate is pressed out and split up by means of hot water and read off by volume.

Dodge suggests destroying the Terpenes with cold 5% Potassium Permanganate Solution and after 24 hours contact dissolving the Manganese Dioxide with Sulphuric Acid and measuring the volume of unoxidised Eucalyptol. C. T. Bennett finds the method works with Oils rich in Cineol, but not with low grade Amygdalina Oil.—P.R., 1912, 276, 295.

If 2 Cc. be mixed with 4 Cc. of glacial acetic acid and 3 Cc. of Saturated Aqueous Sodium Nitrite, when gently stirred should not form crystals of Phellandrene Nitrite (exclusion of oils containing much phellandrene)—U.S.

Off. has this test modified by addition of Petroleum Spirit.

C. T. Bennett and M. S. Salamon find the most correct result out of numerous modifications tried, is by use of 5 Cc. of Phosphoric Acid in the B.P. method instead of 6 Cc.—P.R. 1919, p. 211.

Amygdalina Oil was deofficialised because it was supposed that the efficacy of Eucalyptus Oil is due to Eucalyptol; but it was pointed out in 1885 that the reputation of the Oil in Europe was based upon the use of Amygdalina Oil.—C. D., Dec. 3, 1910.

Phellandrene. $C_{10}H_{16}$ = 135.178 is a large constituent of the oil of *E. Amygdalina*. The irritating effect of some oils when inhaled has been attributed to this body, but the more general view is that the Aldehydes produce it. Phellandrene occurs also in the oil of *E. Risdoni* and many others. It is absent from the oil of *E. Smithii* and oils of that group.

Parry reported (C.D. i./13,358) cases of diluting B.P. Oils with *Amygdalina* Oils so as to come just within official limits.

This we think reflects too much on the honesty of the producer in Australia. Formerly the leaves of the various species used for distillation were not kept separate with the required care, but the venation of the different leaves as laid down by Baker and Smith has enabled both the gatherers and the distillers of leaves to readily distinguish the different species.

Eucalyptus Oil (*Amygdalina* Var.) is used in metallurgy in treating refractory ores, which are ground with water to which a small percentage of the oil is added, the effect of the oil being to bring the mineral particles to the surface.—C.D. ii./10,50. Enormous quantities of the oil have been consumed in preparing sulphides of zinc and lead. About $\frac{1}{2}$ lb. oil is emulsified by vigorous

shaking with about 100 gallons of water, and with this mixture the moistened or powdered ore is stirred. The oil absorbs the sulphide particles and carries them to the surface, together with the gold and silver contained in them, up to 95 per cent. of the actual content of the powdered ore being recovered by the process. The Barrier mines already consume about 10 tons of eucalyptus oil monthly.—Schimel & Co.'s Report, per Anstr. Jl. Ph., Dec., 1911. See also C.D. ii./10,679. "Phellandrene Oils" work better than others and can thus be used up.—Na., June, 1911, 584; P.J. ii./11,30.

West Australian Eucalypts and their Oils.—P.J. ii./95,356,382.

Transvaal Oil is of excellent quality.—P.J. i./09,4.

Aromadendral $C_{10}H_{14}O$ is the levorotatory high boiling aldehyde found in numerous E. Oils. It is a dehydro-aromatic aldehyde discovered by H. G. Smith. It does not occur in the group of oils to which *E. Amygdalina* belongs; the characteristic constituent in this group being Piperitone, a ketone, and the objectionable aldehydes are of low boiling point.—Hudson.

139 species of **Eucalyptus** have been critically revised. *E. Viminalis* and *E. Rubida* yield a kind of manna.—P.J. ii./16,82.

Eucalyptus and other Australian Essential Oils. Conditions of the industry at present. *E. Macarthuri* yielding from 60 to 75% Geranyl Acetate is much in favour.—C.D. '20,746.

* **Cresineol**.—A compound of Cineol with Orthocresol. It can be made by mixing Eucalyptus Oil with Orthocresol. Analogous procedure with meta and paracresol does not produce a crystalline compound, though there is heat evolved. Cresineol has melting point $55.2^{\circ}C$., Sp. Gr. 0.9661. Readily soluble in organic solvents. It is slowly decomposed by weak alkalis and to a slight extent by water. The formation of the compound can be used as a method for estimating cineol.—T. Tusting Cocking, B.P. Conf., 1920.

Resorcin of course produces a compound. Pyrogallol also makes a compound which crystallises out rapidly. Other phenols tried did not act similarly.—W. H. M., 1920.

FERRUM.

Pilula Ferri (Off.).

A little Reduced Iron added would prevent oxidation.

The employment of sodium bicarbonate in place of sodium carbonate, together with plenty of water, a little honey and gum acacia, makes a pill which will keep unoxidised for a long time.

The **Original** formula was published in 1832:—Dried Ferrous Sulphate and dried Potassium Carbonate equal parts with Mucilage of Tragacanth and Powdered Licorice.—P.J. ii./06,369.

Iron acts more as a stimulant to the blood-forming organs than as a constituent of new blood. In whatever way it enters the blood corpuscle iron is an essential factor in treatment.—B.M.J. ii./09,1423.

In pernicious anæmia rapid increase in number of red corpuscles under Bland Pill capsules.—B.M.J. i./09,209.

Patients suffering from chlorosis improve more rapidly under a ferrous carbonate preparation so far as hæmoglobin content is concerned, than under Iron-protein preparations.—P.J. ii./11,16.

Bland Pill Estimation.

The white or other coatings having been carefully removed the weight of two pills should be carefully noted. They are dissolved in a beaker in a small quantity of water, say 15 Cc. with sulphuric acid 5 Cc. Decinormal solution of potassium bichromate (4.87 Gm. in 1,000 Cc.) is then run in until a drop of the solution no longer gives a blue colour with drops of potassium ferricyanide solution arranged on a white tile. Multiply the number of Cc. of Bichromate solution used by 0.0115 to obtain the amount of ferrous carbonate in grammes in the two pills.

Composition of 30 samples of Bland's Pill. Some samples appear to have been made from ferrous carbonate, some contained very little sodium carbonate, whilst some contained potassium carbonate.—P.J. ii./11,320.

Bland's Pills have ceased to be proprietary here though they are the subject of a patent on the Continent.—E. J. Parry, P.M.C.E., C.D. i./13,560.

Ferri et Ammonii Citras Viridis.

To prepare a scale compound of ferric ammonium citrate of a green colour the proportion of acid should be raised to one molecule and a half of citric acid to one atom of ferric iron. Larger quantities of citric acid heighten the green colour, but the salt becomes more hygroscopic.—R. C. Cowley, C.D. 1./11,315.

Some experiments by us on this matter showed that the proportion of Ammonia is also of importance. Very light green scales can be produced by using only $1\frac{1}{2}$ molecules of Citric Acid to 1 atom of "ic" Iron and $1\frac{1}{2}$ molecules of NH_3 . This yields a preparation containing 22% Fe_2O_3 .

Syrupus Ferri Iodidi (Off.).

The addition of *Hypophosphorous Acid* is objected to—it is the instability of Ferrous Iodide that makes it so valuable therapeutically. The absorption of the Iodine is required,—added preservative prevents or retards this. It is recommended to double the amount of iron in the U.S. preparation. Place Iron Wire 25 Gm. in a 500 Cc. flask and wash well with water, add Water 150 Cc. and then Iodine 41.5 Gm. Shake, and when the mixture is of greenish colour and free from Iodine odour boil for five minutes. Filter through a folded filter paper, the point of which dips below the requisite 700 Gm. of Syrup. When the liquid has run through wash the flask and filter with a mixture of Syrup and Water each 25 Cc., previously heated to boiling, finally make the weight 1,000 Gm.—P.J. ii./10,576.

Citric acid $\frac{1}{4}$ % is even better than hypophosphorous acid as preservative.—P.J. ii./09,405.

Ferro-Silicon.—A physico-chemical alloy of Iron and Silicon used in the manufacture of steel goods where easy working and high tensile strength is required, in contact with water or moist air gives off poisonous gas, *i.e.*, Phosphoretted Hydrogen, Arseniuretted Hydrogen *inter alia*, hence dangerous unless correctly used. That containing between 40 to 60% Silicon contains the most impurities.—L. ii./10,220.

Syrupus Ferri Phosphatis Compositus.

Estimation of Iron and Calcium.—The estimations of Iron and Calcium in this preparation have to be conducted separately.

Iron.—Dilute 20 Cc. of the Syrup with water considerably, heat on a water bath, add Ammonia in slight excess and allow precipitate to deposit on the water bath. Collect and wash quickly with boiling water. Ignite and dissolve in Hydrochloric Acid, add Ammonia in slight excess, collect and wash slightly and dissolve in dilute Sulphuric Acid. Reduce by boiling with copper foil and titrate with Permanganate. The iron is expressed as Ferrous Phosphate.

Calcium.—Add about 1 to 2 Gm. of Citric Acid to 20 Cc. of Syrup and a little Hydrochloric Acid. Make slightly alkaline with Ammonia and finally test acid with Acetic Acid. Add Ammonium Oxalate in excess and estimate Calcium as usual.

Some commercial samples ranged from 0.13 to 0.5 grains per drachm of Ferrous Phosphate and Calcium Phosphate from 'a trace' of 0.9 grains per drachm.—Salamon and Seaber, C.D., July 5, '13.

Intramine and Ferrivine.

Intramine is no longer made in the "cream" form referred to in Volume I., pages 413 & 414.

For *intramuscular* use it is now supplied in two solutions to be mixed immediately before use in the proportion of one volume of the No. 1 solution and two volumes of the No. 2 solution. The resulting colloidal emulsion contains one per cent. of Intramine. Dose, 1 to 5 Cc. The injection is not painful, as was the case when the original "cream" form was used.

For *intravenous* use a 0.1 per cent. colloidal emulsion is supplied ready for use in 50 Cc. ampoules. The contents of one ampoule comprise the usual adult dose.

For *internal* use keratinised gelatin capsules are made, each equivalent to 0.5 Cc. of the 1% colloidal emulsion. Dose one to three capsules thrice daily after meals.

For *local* use in the treatment of chronic ulcers, the preparation as supplied for intramuscular injection can be applied twice a day for not more than three days.

For the treatment of syphilis, McDonagh advocates the use of Intramine in addition to arsenical compounds and mercury. Intramine prevents arsenical dermatitis, and diminishes the risk of neuro-syphilis. In the late stages of syphilis the use of Intramine should precede arseno-benzol and mercury. Intramine is stated to act as a specific in cases of metallic poisoning.

In chronic cases of mercurial stomatitis and nephritis, arsenical dermatitis, hepatitis and nephritis and lead poisoning, weekly intramuscular injections of 2·5 Cc. are advocated.

In a case of '606' dermatitis the immediate improvement following the administration of Intramine was very marked.—A. R. Fraser, L. ii./19,480, 481.

One or two injections of Intramine permits the assimilation of much more mercury; in some cases as much as 10 grains of mercurial pill were taken daily with impunity, though previously signs of intolerance had been manifest.—G. W. Rundle, L. i./20,1268.

In cases of toxic jaundice occurring during the early stages of syphilis, Intramine is the best remedy given in doses of 3 Cc. at intervals of five days. In mild cases two doses are sufficient, in more severe cases as many as 10 injections have been given. Exfoliative dermatitis following even two doses of N.A.B. well treated by Intramine 2·5 Cc. intramuscularly in the buttock repeated every fifth day until disappearance of the erythema in simple cases or the exfoliation in severe cases.—E. G. French, L. i./20,1262,1263.

Diortho-amino-thiobenzene is practically a specific for metallic poisoning while the acetyl derivative is as inert as plain colloidal or sublimed sulphur.—C. A. Hill, Pres. Add. B.P. Conf., 1920.

Ferrivine, Vol. I., page 413, has been discontinued.

FILIX MAS.

Extractum Filicis Liquidum (Off.).

Up to a certain period the greater part of the Male Fern Extract of commerce was adulterated with 30 to 60% Castor Oil. Sp. Gr. should not be below 1·0 (Off.) R.I. at 20° C., not below 1·5 usually 1·505 to 1·509. Must dissolve entirely in 10 volumes Petroleum Ether. Saponification value 230 to 250. Unsaponifiable matter 8 to 11%. Fatty Acids should have mean combining weight of 240 to 255. Crude Filicin not less than 20% (Off. requirement).—E. J. Parry, P.J. i./11,778.

Estimation of Filicic Acid in Male Fern Extract.—A series of genuine extracts contained between 19 and 26% of crude Filicic Acid, hence the standard of the P. Helv. (26 to 28%) is thought to be too high. A fair average value should be 22%, and a minimum 20%. The 3% Baryta Solution of the P. Helv., is best for estimating the acid which should be characterised. In sampling it is necessary to stir up well.

Poulson says the Extract contains Filicin in addition to Filicic Acid. The first is amorphous and is deemed active, the latter is inactive and crystalline and is viewed as the lactone of Filicic Acid. Kraft regards the two bodies as isomeric.—C. A. Hill, P.J. ii./13,126.

It would seem best, therefore, in carrying out the assay process of P. Helv. to term the extractive 'Crude Filicic Acid.'

E. F. Harrison examined a number of Commercial Extracts and differed from Parry's limit figures, notably in Crude Filicin content, which may fall below 20%.—P.J. ii./13,128.

A good extract should contain not less than 24% Filicin, yield after purification 3·5% Filicic Acid. In the autumn the percentage of Filicic Acid is higher than in the spring, whilst the percentage of Filicin scarcely ever varies.—From a manufacturer's pamphlet.

Most tæniacide drugs contain a phloroglucin group.—Tschirch, P.J. ii./09,421.

GELSEMI RADIX (Off.).

A standard of 0·5% total alkaloids for the root, and 0·05% for the tincture has been suggested.

'Gelseminine' has been regarded as the soft resinous alkaloidal residue remaining after Gelsemine Hydrochloride has been crystallised from alcoholic solutions of the mixed alkaloids. Cushny regarded this as a powerful poison resembling Conine. L. E. Sayre has separated it into at least two distinct

bodies having different solubilities and different reactions with Reagents. H.W. Emerson reports that Pharmacological examination showed: (1) that 'Gelsemine Hydrochloride' contrary to previous statements has an inherent power as a heart depressant preceded by a period of excitation,—this is not due to admixture of Gelseminine. (2) An alkaloid soluble in Ammonia, which if found to be a separate alkaloid, may be called Gelsemoidine. It is a less powerful depressant than 'Gelsemium' (?). (3) 'Gelseminine' (insoluble in Ammonia) is less toxic than any other one of the poisonous principles. They all have paralysing effect in different degrees.—P.J. i./11,242.

C. W. Moore provided a further paper in which he mentions having purified the 'Gelsemine' and obtained it with M.Pt. 160° of formula $C_{20}H_{22}N_2O_2$ by crystallising from Acetone.—P.J. ii./10,584; C.D. ii./10,52; J.C.S.T. i./11,1231.

N.B.—In both these last two papers the name 'Gelsemine' is apparently given to the alkaloid which we and others have for years past termed Gelseminine. Hence to understand the data in these two abstracts the transposition should be made.

L. E. Sayre contributed a further paper on this subject.—Jl. Am. Ph. Ass., May, 1912, P.J. ii./12,73, obtaining 6.4 Gm. "Gelseminine" (*i.e.*, our amorphous alkaloid Gelsemine) and 0.44 Gm. "Gelsemine" Cryst. (*i.e.*, our Gelseminine) from 50 lbs. of crude material. He suggests that the name **Sempervirine** should replace "Gelseminine" (*i.e.*, Amorphous Gelsemine as we understand it). To us all, this dispute over the naming of the body appears unnecessary—especially so late in the day.—See also Y.B.P., 1920, p. 10.

Identification of Gelsemium.—It does not contain any Aesculin. The fluorescent body is Scopoletin (Aesculetin—5—Methyl Ether). If 0.5 Gm. of the ground drug be heated in a tube with Chloroform, the mixture filtered and the filtrate shaken with water to which a few drops of Dilute Ammonia have been added, the aqueous layer on separation shows distinct blue fluorescence,—indicating presence of Scopoletin.—F. Tutin, P.J. i./12,157.

GLUCOSUM.

Glucose may contain sulphur dioxide and hence be unsuited for pharmaceutical syrups, causing change in colour and production of odour.

TEST.—To 10 Gm. dissolved in water *q.s.* to 50 Cc. add 1 Gm. Sodium Hypophosphite and then Phosphoric Acid (1.5) 10 Cc. Cork the container and place in a warm place for a few hours. The sulphur compounds can then be detected by odour.—W. B. Cowie, P.J. i./16,235.

GLYCERINUM.

Glycerin occasionally crystallises. Such crystals melt at 17° C.

Fat decomposition and recovery of Glycerin.—Am Jl Ph., Feb., 1910,717.

For the Estimation of Glycerin in Glycerol.—Am Jl Ph., Feb., 1910,717. (Naylor) consult—P.J.ii./09,131,139, B.C.D.ii./09,138, or Edition XIV., p. 339. For a new method see P.J. i./12,157.

Glyceryl Carbonates.—Glycerin and Phenyl Carbonate react at moderately high temperatures in vacuo. The completely saturated product is a solid crystalline substance with M.Pt. 138° C.—insoluble in water. Phosgene may also be used.—Patent 19,924 of 1911, *vide* P.J. ii./12,299.

Ultra violet rays from a powerful Mercury-quartz lamp decompose Glycerin with formation of Formaldehyde.—P.J. ii./12,7.

Glycerinum Boracis.

It is thought that the bodies combine to form Glycerol-Boric Acid, a monobasic acid expressed by the formula $HC_3H_5OHBO_3$ —this has however not been isolated.—P.J. i./11,90,104.

Microscopic Glycerin Jelly.—

Dissolve Gelatin 12.5 in Water 100, add Glycerin 100 (warmed) clarify with egg albumen 12.5 and to the product add Salicylic Acid 1 in Alcohol 12.5. We find this formula to work satisfactorily.

GLYCYRRHIZA. (Off.).**Glycyrrhizinum Ammoniatum, U.S.**

According to some views (*c.f.* P.J. i./11,258) 'Glycyrrhizin' now applies to the sweet substance found in liquorice root by Tschirch to be a mixture of Calcium and Potassium Glycyrrhizates and hence containing neither Ammonia nor Nitrogen. This mixture is colourless when pure, the yield being about 3%.—*c.f.* Y.B.P.—1907, p. 73.

Tschirch discovered that Glycyrrhizinic Acid is the Diaglycuronic Acid ester of Glycyrrhetic Acid. It has glucosidal properties. Glycuronic Acid, is of importance in animal life—an unexpected fact, as the most varied sugars are at the disposal of a plant if it wishes to form Glucosides.—P.J. ii./09,421; *c.f.* also Y.B.P., 1907, 73.

Liquorice Juice of commerce contains 10 to 15% and more of Glycyrrhizin. White Cross Congress required only 6%. Umney.—C.D. ii./09,580. See also P.J. i./06,494; C.D. i./10,21.

Analysis of Liquorice Juice. A minimum of 9% of 'Glycyrrhizin' should be present in normally prepared edible juices—they should not contain more than 18% of sugars, reducing and non-reducing. In order to determine whether the starch present (genuine juice may have starch present owing to crude method of filtration) be actual or added, the sample should be powdered, extracted with water and the residue taken up with 3% Ammonia Solution. The insoluble matter should never exceed 6%. Examine this under the microscope to trace source of starch, *i.e.*, whether added or of the same character as that in the root. The amount not dissolved in 70% alcohol should not exceed 16.5%. Gum should never be present in pure Liquorice Juice.—Parry, C.D. i./11,133.

Licorice Root and Extract. Method of examination. The resins are confined to the bark of the root. With 'mild' extraction with hot water they remain mostly in the marc.—Am. Jl. Ph., Dec., 1912.

Thirty-two samples of powdered liquorice examined. Three of the samples yielded less aqueous extract and nine exceeded the ash limit.—Professor H. G. Greenish and Dorothy J. Bartlett.—P.J. i./13,365,370.

Off. requires not less than 20% extract by Chloroform Water in the cold.

GUAIACI RESINA.

The **PHYSIOLOGICAL ACTION OF GUAIACUM RESIN** is we believe not completely understood. The drug is acknowledged to have useful effect in gout and rheumatism.

In 1912 we conducted investigations to determine whether this Resin increases or decreases the elimination of Uric Acid from the human body. It was suggested (A. E. Garrod) that Guaiacum has a distinct effect in reducing the amount of Uric Acid excreted, *i.e.*, it was thought that the Uric Acid is eliminated in some other form, possibly Hippuric Acid.

A normal individual took Guaiacum Resin in 5 grain doses daily in the morning and the Uric Acid was estimated in the urines the same afternoon. Hippuric Acid was also estimated in specimens of the same urines by the method given by Allen, "Chemistry of Urine," p. 186. After a day's interval the Acids were estimated on several days without administration of the drug. The two series were then repeated on the same lines after an interval. Seeing that the diet of the individual could not well be controlled in weighed amounts of food as would strictly be necessary for an investigation of this kind, it was thought that to express the results in percentage Ratios of Uric Acid to excess of Solids (R.U.A.) over Water might yield more comparable results.

Joulie employs this method of indicating the constituents of Urine by Ratios *c.f.* Phosphates in Urine. Thus, taking a specimen of urine with the following 'Normal' factors in Gm. per litre.

Specific Gravity ..	1017.8	Cl. ..	..	6.865
Excess of Solids over Water	17.8	Urea ..	..	18.75
Physiological acidity in terms		Uric Acid ..	..	0.416
of H_2SO_4 ..	0.849	Hippuric Acid ..	..	1.3
Total P_2O_5 ..	2.083			(mean)

one may express the constituents as the following percentage ratios:—

Normal.	
'R.A.' Ratio of Physiological Acidity to excess of Solids over Water ..	4.77 (i.e. $\frac{0.849 \times 100}{17.8}$)
'R.P.' Ratio of total P_2O_5 to excess of Solids over Water ..	11.17
'R.U.' Ratio of Urea to excess of Solids over Water ..	100.53
'R.U.A.' Ratio of Uric Acid to excess of Solids over Water ..	2.33
'R.H.A.' Ratio of Hippuric Acid to excess of Solids over Water ..	7.3
R.P./R.A.' Ratio of Phosphoric Acid to ratio of Acidity (Joulie's factor) ..	2.45
Ratio of Uric Acid, for example, is arrived at thus :	$\frac{0.416 \times 100}{17.8} = 2.33$

The results which we obtained gave an

Average Uric Acid Ratio under Guaiacum Resin ..	=3.39
without ..	=3.19
" Hippuric Acid Ratio under Guaiacum Resin ..	=5.43
" without ..	=4.99

The quantity of Hippuric Acid normally found is known to vary enormously, *e.g.*, between 0.02 and 0.25%. From this we deduced for purpose of this investigation a mean normal R.H.A. of 7.3. A number of other investigations were conducted on analogous lines but need not be recorded. A table showing the actual data was given in our last edition.

We observed an average increase of Uric and Hippuric Acids during the ' + Guaiacum periods.' The amount of each Acid from day to day was seen to be erratic and the process of estimation of Hippuric Acid is not accurate. A. E. Garrod's opinion in the matter may yet be substantiated by further work, which we think would prove an interesting theme for someone in hospital practice, with facilities for keeping patients on exact diet.

HAMAMELIS.

Liquor Hamamelidis.

U.S. IX. now employs the bark, twigs, smaller stems or the entire shrub of the plant collected in the autumn for distilling the liquor. Previously the dried bark was used officially in the U.S.P., while the fresh leaves were and are directed for use in this country—*Off.* This appears anomalous. We have obtained a liquor comparing favourably with both by using the *dried* leaves. We have also distilled the fresh leaves grown in this country, *c.* Vol. I., p. 443.

Is chiefly prepared in the States of Massachusetts, Connecticut and New York from the small twigs preferably in the fall, when the leaves are off. From a ton of twigs 50 to 80 gallons of distillate is produced, to which 5 to 10% of alcohol is added to prevent change.

Essential Oil of Witch Hazel.—H. A. D. Jowett and F. L. Pyman found that its chief constituent is a sesquiterpene, other constituents being a phenolic substance, a mixture of fatty acids and a mixture of solid saturated hydrocarbons.—P.J. ii./15, 129.

HEXAMINA.

Experiments to determine which of the following:—*Hexamethylene-tetramine itself, Formaldehyde set free therefrom in an acid urine, or even the Acid Sodium Phosphate alone used to increase the acidity of the urine,—is the active agent in overcoming bacilluria.*

¶ Jordan stated that a substance causing acidity of the urine (*e.g.*, Sodium Acid Phosphate) must be simultaneously given.—B.M.J. ii./13,651.

In Hexamine treatment give alkali to first neutralise poison of pure *B. Coli* infection and when symptoms subside give antiseptics in progressive doses.—J. W. T. Walker, B.M.J. ii./13,654,657.

Therapeutic effect depends on the liberated Formaldehyde—this only occurs in truly acid body fluids. Hexamine is in itself not bactericidal.—B.M.J.E. ./14,28.

Infection of the Urinary Tract in Children by Coliform Organisms.—The usual treatment was (1) Alkalis, (2) Urinary Antiseptics, (3) local treatment of the bladder. None of them seemed of much value. The alkalis have been widely used with the idea that *B. Coli* does not thrive in an alkaline medium. This is not strictly true. It grows quite well in same but also grows well in an acid medium, while the usual pyogenetic organisms will not. The reason why the urine of these cases is acid is because *B. Coli* does not split up urea. Local treatment by washing out the bladder and injecting Iodoform seems to have good effect. Vaccines do good to the general condition but seldom remove pus from the urine.—W. M. Jeffreys, Q. Jl. Med., Apl., 1911, 267 *et seq.*

B. Coli thrive in Urotropinised urine (if alkaline).—Pr., '09,658.

HYDRARGYRUM.

Mercury, Detection of in Human Hair.

An amount corresponding to 1 in 90,000,000 can be found using 2 to 10 Gm. of the hair—in those who have undergone Mercurial treatment.

Free the specimen from grease by washing with ether, alcohol, and water, then digest in hydrochloric acid containing potassium permanganate. On complete solution treat with H_2S . Collect pp. and treat with Potassium Chlorate and Hydrochloric Acid. Filter and evaporate to small bulk. Boil gently a strip of copper foil in same. Dry the foil and place in a tube one end of which ends in a capillary. Exhaust and seal, then heat in a flame so as to sublime the mercury in the capillary. Globules may then be seen under the microscope.—L. ii./12,1737; P.J. i./13,31.

Hydrargyrum cum Creta.

It is a good plan to add a few drops of Ether to the Mercury in the mortar—then fan to remove the bulk of it and finally add the Chalk with moderate trituration.—P. Boa, C.D. '20,279. See also D. B. Dott, P. J. ii/20,131.

Mercuric Oxide is useful as a Volumetric Standard in Acidimetry and Alkalimetry and in Iodimetry, Oxidimetry and Argentometry. It is obtainable chemically pure. For method of proceeding in each case see Rosenthaler and Abelman.—P.J. ii./13,144.

Iodides interact with Mercury and its salts forming Mercuric Iodide—this proved fatal in a child at Coventry receiving inunction of Ammoniated Mercury Ointment and simultaneously a solution of Iodine locally for ring worm.—P.J. i./13,208.

Hydrargyri Subchloridum.

Finely Divided Calomel. (Duret.)

Dissolve Sodium Bicarbonate 6 Gm. and Glucose 10 Gm. in Distilled Water 80 Cc.

Then dissolve separately Magnesium Chloride Cryst. 7.5 Gm. in water 20 Cc.

Mix the above and add to a third solution consisting of Mercuric Chloride 11.5 Gm., Hydrochloric Acid 10 drops and water 100 Cc. Shake well and allow to stand. Carbon Dioxide is evolved. When this slackens warm on water bath until no more gas comes off; wash and dry the precipitate. Yield 10 Gm. of a light form of Calomel which may be more active for local use.

We have made the calomel by this formula. It is very similar to the sealy calomel recommended by Burden Cooper some years ago for ophthalmic use.

Prophylactic Ointment. (Duret.)

Calomel made as above 10, Magnesium Chloride Cryst. 10, Sodium Bicarbonate 7, Thymol 0.15, Camphor 0.35, Glycerole of Starch 15, Arachis Oil 15, Wool Fat 20, Water. 25.

Triturate the Magnesium Chloride and Sodium Bicarbonate with the water add the Calomel and the Glycerole of Starch; melt the Wool Fat with 10 Gm

of the Arachis Oil, and to this add the Thymol and Camphor dissolved in the remaining 5 Gm. of Oil. While still liquid add this to the first mixture and beat together until homogeneous. As a mercurial preparation it is well absorbed.—B.M.J. i./19,713.

'Packets' for Venereal Disease.—The Ointment is Calomel 33 Lanolin 67. Vaseline 10. The other packet is Potassium Permanganate to produce 1 in 1,000 solution for washing.—P.J. i./20,576.

Hydrargyri et Potassii Iodidum.

Mayer's Reagent. **Tanret's Reagent** is identical in composition.

Mercuric Chloride 13.546 grammes, Potassium Iodide 49.8 grammes. Distilled Water to 1 litre. This reagent gives a precipitate with alkaloids.

Formerly methods of volumetric estimation of alkaloids by means of the above were in vogue, but the composition of the precipitates is variable.

Mercury-Potassium Iodide Tablets for Lotions.

Syn. Biniiodide Tablets.

We prepare these to contain $8\frac{1}{2}$ grains of Anhydrous Mercuric Potassium Iodide ($\text{HgI}_2\cdot\text{KI}$) with a sufficiency of Potassium Iodide in excess to make the body $\text{HgI}_2\cdot 2\text{KI}$ as explained Vol. I p. 458. One dissolved in 1 pint of water makes a 1 in 1000 Solution of Mercuric Potassium Iodide.

These contain 6.37 grains of Mercuric Iodide HgI_2 . A trade custom has developed, however, of making them on various assumptions, *e.g.* to contain $8\frac{1}{2}$ grains of the soluble Iodide $\text{HgI}_2\cdot 2\text{KI}$, which renders the content of Mercuric Iodide in the solution far less, namely 5 grains.

There are various formulæ assigned to Mercuric Potassium Iodide—solid and in solution, and these form the basis of scientific disagreement and commercial advantage. So far as this work is concerned, the **Mercuric Potassium Iodide basis** as first mentioned is **intended**.

To estimate the Mercury in Lotion Tablets of this kind, Formalin reduction as recommended by E. Rupp is used. For the Iodine the Iodate Reaction in presence of strong Hydrochloric Acid. $2\text{HI} + \text{HIO}_3 + 3\text{HCl} = 3\text{ICl} + 3\text{H}_2\text{O}$. The whole matter is well dealt with in a paper by A. J. Jones, C.D. '20,523.

Hydrargyri Oxycyanidum.

Manufacture.—To obtain the pure salt Mercuric Cyanide 40 Gm. and yellow Mercuric Oxide 30 Gm. are mixed and then made into a smooth cream with water 15. On stirring reaction occurs and almost a jelly is produced. 0.5 Cc. of Caustic Soda Solution 20% is then added with further stirring. The colour rapidly changes and the mass stiffens. Water is added to make the mixture workable and it is allowed to stand overnight. Dilute with water 200 Cc. and render acid to Phenolphthalein with Acetic Acid. Transfer to a flask containing about 700 Cc. of boiling water with 20 Gm. Mercuric Cyanide in solution. Continue heating until dissolved and set aside to crystallise.

The pure substance is dangerous. It explodes at 190°C . It begins to decompose at 160°C .

Some control their product so as to contain respectively 40 and 50% Oxy-cyanide, the remainder being Cyanide.—A. J. Jones, B.P. Conf., 1920.

Unguentum Hydrargyri Nitratis.

Martindale's Formula for Citrine Ointment.—Use only one-third of the *Off* quantity of Acid and a volume of water equal to volume of Acid to dissolve the Mercury (in the cold), also employing White Vaseline in place of the lard, and a temperature of 87°C . for mixing. Stir until cool and smooth. Even this reduced quantity of acid is more than theory demands for making Mercurous Nitrate (and slightly more than theory for Mercuric Nitrate), but excess of acid appears to be necessary for keeping qualities. Furthermore, the water we found was also desirable. This ointment examined three months after making was of good colour, smooth, and easily rubbed into the skin.

(NOTE.—*Off.* now maintains temperature 90°C . until frothing ceases)—the mixed lard and oil has initial temperature 150°C .

The principle on which the official ointment is made appears to be that the Nitric acid acting upon the mercury in the cold produces Mercurous Nitrate and Nitrous Acid, an excess of Nitric Acid being present. On adding to the

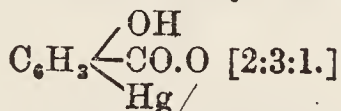
fat the Nitrous Acid forms elaidin, and the heat of the fat causes oxidation of the mercurous salt with formation of more Nitrous Acid from the excess of Nitric Acid present. The excess of Nitrous Acid is driven off in the form of Oxides of Nitrogen.

Some discussion took place regarding the composition of this ointment Cowley maintains that "it does not contain any nitrate of Mercury whatsoever." His statement is to the effect that Mercuric Nitrate is entirely decomposed in the presence of fats and that the product consists of "Mercuric compounds of Elaidic Acid and Acids produced by the oxidation of the fats."—C.D., Jan. 7, 1911.

We provided (C.D. i./11,63) the results of our experiments undertaken with a view to settling the matter. A separation process to define the exact form of the mercury is by no means easy to devise owing to the various complications present. A very large proportion of the Mercury is certainly present in a condition soluble in ether and in Petroleum Ether. We then conducted a number of further experiments on the subject. Without describing same in detail we may say that our methods consisted (1) in finding the limit of solubility of Mercuric Nitrate in Petroleum Ether then determining the amount of Mercury in a Petroleum Ether solution of the Ointment using considerably less than the amount required for dissolving the $\text{Hg}(\text{NO}_3)_2$, possibly present. (2) Mixing $\text{Hg}(\text{NO}_3)_2$ in proportion assumed in the Ointment with the fatty ingredients and then estimating, using Petroleum Ether as above. We are inclined to agree from this work that the Mercury is, in the main, not in the form of Mercuric Nitrate, but on the contrary at least 50% of it is in the condition of salts of fatty acids or their oxidation products, and that practically all the Nitric Acid is decomposed or dissipated by the process of manufacture

Hydrargyri Salicylas.

P.G. terms the Compound Mercuric-Salicylic Acid and gives the formula



It will be seen that this indicates an entirely distinct composition from that usually assumed—the Mercury being linked direct to the Benzol ring. Schmidt, we notice, favours a compound of this formula—he draws attention to the slow precipitation of the mercury contained by Sulphuretted Hydrogen in support of the new view.

Patented Compounds with Hydrocyanic Acid, said to be valuable Antisyphilitics of mild action, and non-corrosive—suitable for subcutaneous injection.—P.J. ii./10,685.

Mercurochrome '220' *Syn.* Dibromo-oxy-Mercury Fluorescein (or its Sodium Salt).

As a vesical antiseptic 1% aqueous solution is tolerated by the bladder for 1 to 3 hours and occasions no pain. Rapid in action in refractory cases of cystitis and pyelitis, also used in gonorrhoea, chancroids and as dressing for buboes. In vitro 0.1% kills *B. Coli* and *Staphylococcus aureus* in urine in one minute.—Jl. Am. Med. Assn., 1919, 1483, abst. P.J. i./20,6. B.M.J.E. i./20,20.

HYDRASTIS RHIZOMA.

Assay Method.—The drug in No. 60 powder is treated with ether, ammonia and water. A volume of the filtrate is shaken out with sulphuric acid and water. The acid solution is rendered alkaline with ammonia and shaken out with ether, the ethereal solution is evaporated and the residue weighed. U.S. IX. process is on this principle (not less than 2.5% alkaloids). *Off.* is not standardised though the Liquid Extract *infra* is.

History of Hydrastis.—P.J. i./11,824.

There appears to be considerable loss in alkaloid in extracting the drug for Liquid Extract. Judging from Mann's figures—about 2% should be expected in a well made extract.—P.J. i./09,366; C.D. i./09,426. This strength is now *Off.*

Hydrastina (Alkaloid).

To distinguish from Hydrastinine :—A solution of about 0.1 Gm. in 10 Cc. dilute sulphuric acid shows no blue fluorescence, but on gradually adding Potassium Permanganate Solution 1 in 10, avoiding excess, the fluorescence develops. (U.S.)

Hydrastinina.

Synthetic Hydrastinine, using piperonal as starting point. Piperonal, known as heliotropin in the perfume industry, is cheaply made from safrol, the waste residues of the manufacture of camphor from camphor oil. Decker (Zeitf. Angew. Chem., 1911, 40); (c.f., also Cotarnine).—C.D. ii. /11,650.

Hydrastinine Hydrochloride. *To detect Hydrastine.*—In an aqueous solution of the salt (1 in 20) Bromine water produces a yellow precipitate which is completely soluble in Liquor Ammonie, producing an almost colourless solution.—U.S.

For Foreign Alkaloids.—A few drops of Ammonia Solution added to 1 Cc. of an aqueous solution 1 in 20 of the salt produces no turbidity.—U.S.

HYDROGENII PEROXIDI LIQUOR.

In the customary process of estimating the volume of Oxygen produced in a Nitrometer with Permanganate and Sulphuric Acid it is better to use saturated Magnesium Sulphate solution rather than Sodium Chloride Solution.

Copper Ammonium Sulphate Solution is now used instead of Permanganate and Acid.—*Off.*

P.G.V. gives method of estimating by titrating Iodine liberated from Potassium Iodide.

Rapid Method of Estimating.—Titrate 2 Cc. in presence of a little dilute Sulphuric Acid with a solution of Potassium Permanganate 5.06 Gm. per litre until decolourised. Each volume of this solution is equivalent to an equal volume of Oxygen. 1 Cc. of 10 volume H_2O_2 decolourises 10 Cc. of the Permanganate and 1 Cc. of 20 volume will decolourise 20 Cc. of it.—C.D. i., 06,211. The explanation is :— $2KMnO_4 = 5$ atoms oxygen $\therefore 316.06$ Gm = 55.8 litres Oxygen, i.e., 5.66 Gm = 1 litre Oxygen \therefore 1 Cc. of the Permanganate Solution of this strength = 1 Cc. of Oxygen or 0.000287 Gm. approx.

Preservatives.

Benzoic Acid 0.05% added to Hydrogen Peroxide Solution is said to be a good preservative.

A little phosphoric acid is sometimes added as preservative. Acetanilide has also been employed and is said to be useful. It is thought to be first converted into aniline acetate, then oxidised to nitro-benzene, recognisable by the odour developed. (*v. infra*).

Acetanilide 0.002% with Hydrochloric Acid 0.02% or with Phosphoric Acid 0.1% will keep 10 vol. Hydrogen Peroxide for several weeks. The first combination was best of the series, but the loss in strength is nevertheless grave. The loss after keeping 4 years amounted to 70 to 99%.—H.R. Jensen B.P. Conf. 1920.

Acidity Determination.

A neutral solution of Hydrogen Peroxide to retain activity is almost impossible. A limit of acidity should be defined—*Off.*—J. S. White, P.J. i./15, 316.

Direct titration (U.S.P. method) using Phenolphthalein as indicator is the correct index of acidity. Methyl orange (as used *Off.*) does not give a sharp end reaction.—A. J. Jones, P.J. i./15, 376.

The U.S.P. method introduces several sources of error—traces of Ammonium salts, Acetanilide or other preservatives vitiate the result. Methyl Orange preferred.—T. Callan, *ibid* 413.

Sodium Acid phosphate detected in.—H. B. Willson, *ibid*. 450.

Acetanilide is the usual preservative added—1/100 grain to each fluid ounce. A. J. Jones still maintains that Phenolphthalein is best, and concludes as a limit test that 25 mls should require (in the cold) not more than 4 mls of N/10 NaOH using that indicator—*ibid*. 476. See also W. Honneyman, *ibid*. and 512.

There appears to be some confusion throughout this correspondence regarding the U.S.P. test—U.S. VIII., it is true, directs to evaporate 25 Cc. of the solution with 5 Cc. N/10 KOH, and then to titrate finding the end reaction 'after continued boiling,' but the *current* Edn. (U.S. IX.) titrates *in the cold*.—W. H. M.

Concentration of Hydrogen Peroxide.

Certain experiments. — Pharmacal Notes.—Sept., 1912, showed that a 10 vol. Hydrogen Peroxide Solution (containing a little acetanilide as preservative) evaporated to half its bulk in a clean vessel at N.P. has approximately double its Hydrogen Peroxide strength. The actual figures were:—

1000 Cc.	Actual Hydrogen Peroxide	3.04%.
450 "	" "	6.52%.
300 "	" "	9.89%.
200 "	" "	14.7%.
100 "	" "	25.2%.
50 "	" "	43.2%.

We do not find this substantiated except in the *presence of Acetanilide in excess of the quantity commonly stated*:—

1000 Cc. of 10 vol. Hydrogen Peroxide *sine* Acetanilide had strength 3% Hydrogen Peroxide. Evaporated to 300 Cc. the strength was 4.8%.

1000 Cc. with 1/100 grain Acetanilide to the ounce of Solution, evaporated to 300 Cc. showed a slight increase in strength. Evaporated further, *i.e.*, to 126 Cc., there was a marked *loss* of Hydrogen Peroxide not an increase

1000 Cc. with 1/100 grain Acetanilide **to the ounce of actual Hydrogen Peroxide, *i.e.*, $\frac{1}{3}$ grain approx. of Acetanilide per ounce of H_2O_2 Solution,**—

Evaporated to 500 Cc., showed strength 6% Hydrogen Peroxide Solution.

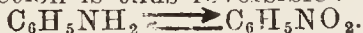
Evaporated to 300 Cc., showed strength 9% Hydrogen Peroxide Solution.

Evaporated to 120 Cc., showed strength 17% Hydrogen Peroxide Solution.

The same author repeats (P.J. i./14,536)—as a preservative 1/100 grain of Acetanilide to each fluid ounce is 'usually employed.'

We think '**per ounce of Hydrogen Peroxide**' is intended, at any rate this is the case in our evaporation experiments.

With regard to the Acetanilide *first undergoing hydrolysis to form aniline and acetic acid, and the aniline then being oxidised to nitrobenzene*, it is possible that at this stage the nitrobenzene undergoes hydrolysis, re-forming aniline and hydrogen peroxide. The aniline thus formed is oxidised back again to nitrobenzene, and the action is thus reversible:—



As the hydrogen peroxide is continually at work as well as being continually re-formed, the rapid deterioration of the solution is prevented.

Nitrosobenzene is more probably the oxidation product. It is well known that Caro's Acid (a compound of H_2O_2 and H_2SO_4) oxidises Aniline to Nitrosobenzene thus:— $C_6H_5NH_2 + 2H_2SO_5 = C_6H_5NO + 2H_2SO_4 + H_2O$. The product might revert again by interacting with water, but this is doubtful.

Acetanilide alone does not seem to preserve H_2O_2 . A specimen containing 0.024 Gm. per 100 Cc. ($=\frac{1}{3}$ grain per ounce approx.), on neutralising with calcium carbonate rapidly lost its strength. The original did not appreciably lose strength but became yellow and smelt similar to nitrobenzene.—H. Finnemore, P.J. i./14,421. Further references on this subject.—P.J. i./14, 275,390.

HYOSCINA.

CRIPPEN POISONING CASE.

Hawley Harvey Crippen was convicted on October 22nd, 1910, of having poisoned his wife with Hyoscine Hydrobromide 5 grains of which he had purchased. Dr. W. H. Wilcox found altogether $\frac{3}{4}$ grain of Hyoscine, equivalent to $\frac{2}{3}$ grain of Hyoscine Hydrobromide, and he expressed the opinion that there must have been more than $\frac{1}{2}$ grain in the body as a whole though far more than that had probably been used. The sales were made as retail sales and recorded in the Poisons Book kept for the purpose. '*The fact that a purchaser was a medical practitioner, whether registered or not, does not necessarily convert the sale of a poison by a retailer into a wholesale transaction.*'

(*Retailers should err on the safe side in the sale of Part I. Poisons*).—(C. and D.).

There was some uncertainty as to how the Hyoscine was administered—Crippen stating that he had made it into Tablets for his patients by impregnating ready-made sugar discs with the medicament. There appeared to be the general assumption in the case that Hyoscine is little used except in mania—that is, of course, very far from the facts, *vide* 'Uses' *Vol. I.*, p. 480.

It is the only drug described as useful in certain forms of *erethismi-urethritis*—in doses of $\frac{1}{300}$ grain twice daily. White and Martin's "Genito-Urinary Surgery," per J. C. McWalter (C.D. ii./10, 63).

The mydriatic alkaloid found could have been one of three,—either Atropine, Hyoscine or Hyoscyamine. The alkaloid from all the organs under examination gave definite purple violet colour by **Vitali's Test** (*q.v.*)—turning to a brownish colour. The base was found to be gummy not crystalline. On treating a solution with Bromine in Hydrobromic Acid brown spheres were obtained. Hyoscyamine and Atropine gave crystals with this test.

The distribution of the alkaloid and the fact that the best preserved organs gave the most yield excluded the possibility of its being a ptomaine from putrefaction. The melting points of the Gold Chlorides vary,—that of Atropine is 148°, Hyoscyamine 160°, and Hyoscine 199°, but apparently insufficient for determining the melting point was obtained.

It is remarkable that the alkaloid should have remained unaltered so long and in such conditions,—as the material had undergone considerable decomposition. Strychnine is well known to withstand exposure, and recently Aconitine (*q.v.*) has been found to be resistant to decomposition.

At the time we undertook a control experiment of this kind. On 1st December, 1911, $\frac{1}{2}$ grain Hyoscine Hydrobromide was dissolved in 1 ounce of Water and mixed with 2 lbs. Minced Cats' Meat; in addition 2 lbs. of the meat were operated upon without addition of Hyoscine, as control. This was left exposed two months; it was then in an advanced state of decomposition—strongly alkaline, of pasty consistence and having a putrid odour, the weight in each case had decreased by about 45%. The two specimens were extracted with Methylated Spirit, acidified with Acetic Acid (effervescence), the liquids evaporated at about 40° C. to small bulk and extracted with Chloroform in the usual manner. These extractives tested with Alkaloidal Reagents gave the following:—

Mayer's Reagent and **Dragendorff's Reagent** gave precipitates with both extractives.

The extractive from the Hyoscine-treated meat gave precipitates with **Gold Chloride** and **Picric Acid**, but the *Control did not*.

Finally the extractive from the Hyoscine-treated-meat gave definite **Vitali's Reaction** which was *not obtainable* in the case of the control. Our result is interesting as showing that the Alkaloid Hyoscine remains intact and capable of isolation and recognition whilst in contact with a large amount of animal material undergoing putrefaction for a lengthy period of time.

HYOSCYAMI FOLIA.

The B.P. states the leaves of *H. Niger* collected from the flowering plants and dried are to be used in making the tincture. If the biennial leaves are used the tincture makes an opalescent or slightly milky solution water. If the annual plant is used it makes a clear solution. The 'flowering tops' wording as in the 1898 B.P. might have remained.—E. M. Holmes, P.J. ii./15, 6.

IODUM.

The potentialities of **Kelp** as a source of alkaline and other salts—the largest natural source of Potassium and Sodium Salts. Potassium Chloride, Sulphate, Carbonate, Sodium Carbonate, Ammonium Sulphate, Acetate of Lime in addition to Iodine could be profitably recovered.—B.C.D., May 31/1912.

Iodine content in Kelp would be in the neighbourhood of 1%. Potassium chloride would be about 30%.

In estimating Iodine in organic Iodine Compounds, it is a good plan to saponify with KOH 2 Gm. Water 12 Cc. and Alcohol 30 Cc. After cooling place in separator and make acid with H_2SO_4 ; add Chloroform and then a

few drops of NaNO_2 Solution. Shake and withdraw the Chloroform, and then add a little more NaNO_2 and more Chloroform, and so on until all Iodine is removed. Wash with water, add NaHCO_3 and titrate with $\text{N}/10 \text{ Na}_2\text{S}_2\text{O}_3$.—P.J. ii./11,711, *c.f.*, Thyroid Gland, Martindale's estimation process.

Limit of Color produced by Iodine visible in Carbon Disulphide, and in Chloroform and Ether:—

In Carbon Disulphide and Chloroform we found decided mauve color is visible in 1 in 500,000 solution. In Ether the brown color is visible in the same dilution.

ESTIMATION OF THE 'IODINE NUMBER' OF A FAT OR OIL.

In the following method Chlor-Iodine addition products are formed of the glycerides of the unsaturated fatty acids and the acids themselves that are contained in the oils so treated.

The Iodine Number indicates the percentage of iodine capable of absorption. Hübl's Iodine Solution is prepared. Dissolve Iodine 25 Gm. in Absolute Alcohol 500 Cc.; dissolve Mercuric Chloride 30 Gm. in a further 500 Cc. of Absolute Alcohol, filter and add to the first solution. Allow to stand twelve hours or so, and ascertain the strength of iodine by a standard sodium thiosulphate solution in the customary manner.

0.8 Gm. of the fat, or 0.3 Gm. of a drying oil, or 0.4 Gm. of a non-drying oil is accurately weighed out and dissolved in 10 Cc. of chloroform. To the solution in a stoppered vessel 20 Cc. of the Hübl's Solution are added, and if the mixture becomes decolourised on standing a short time a further 10 Cc. of Hübl's Solution are added. Then add 10 to 15 Cc. of Solution of Potassium Iodide 10% and dilute the whole with 150 Cc. of water. Determine the free Iodine with thiosulphate and starch, shaking thoroughly. Conduct a blank experiment with the same quantities of chloroform, iodine, &c., deduct the quantity required in the original experiment from the volume of the thiosulphate solution used in this blank experiment and calculate into the equivalent of iodine—this again is to be calculated into units per cent. of the oil.

Example.—0.8 Gm. of a fat required 36—7 Cc. of Thiosulphate Solution = $\frac{0.3651 \times 100}{0.8}$
29 Cc. = 0.3561 Gm. Iodine, therefore 100 of the fat combines with

Iodine = 45.6 which is therefore the Iodine Number of the fat.

IODINE NUMBERS OF CERTAIN OILS AND FATS.

Almond Oil 93—101.9.

Apricot-kernel Oil 100—108.

Arachis Oil 85.6—105.

Cacao-butter 34.0—37.7.

Castor Oil 83.4—85.9

Coco Nut Oil 9.5 (but see also Vol. I., p. 96).

Cod-liver Oil 126—141.

Cottonseed Oil 102—116.9.

Human Fat 61.5.—L. ii./07,691.

Japan Wax 4.2—6.6.

Lard 46—63.8.

Linseed (boiled) Oil 73.7—101.3.

Linseed (raw) Oil 170—187.7.

Maize Oil 111—122.9.

Neatsfoot Oil 62—72.

Olein (pure) 81.7.

Olive Oil 77.28—88.

Poppy Seed Oil 132.6—143.3. We found recently 138.1.

Sesame Oil 102.7—112.

Rape Seed Oil 97—106.

Soya Oil 121.3—123.2. (*Vide* also Vol. I., p. 824. We found only 80.8, with a doubtful sample).

Sperm Oil 81.3—85.

Sunflower Seed Oil 119.7—135. We found recently 136.1.

Fats dissolve more than 5 times as much nitrogen as an equal volume of water or blood plasma. Caisson disease depends on this.—L. ii./07,691

Comparative examination of the Halogen absorption of oils by Hübl's and other methods; the bromine method of McIlheney is better than the iodine ones.—P.J. ii./09,146,201.

Halogen Compounds of fatty acids formed by Hübl's Reagent.—P.J. ii./11, 437.

The French Codex Tinct. Iodl (*c.f.* Vol. I., p. 502) can be replaced by **Glycerinum Iodi** (1 in 60). This is miscible, at least temporarily, with water. Six grains of Iodine per day has been tolerated by this.—H. J. Sadler, C.D. '20, 835.

IPECACUANHA.

The U.S. IX. Assay method is similar to the *Off.*, excepting that the alkaloidal residue is finally titrated instead of being weighed. Cochineal is the Indicator.

Methods of assaying with results: Brazilian, alkaloidal content about 2.2% Carthagena about 2.0%.—P.J. i./03,425; ii./04,475.

Review of the current methods of estimation. Titration of the residue should be insisted upon.—P.J. ii./05,124.

Colour reactions of the alkaloids similar to those of morphine.—Y.B.P., 1903. 96.

Paul and Cownley stated the average composition of Rio and Carthagena alkaloids to be: Emetine in Rio 72 per cent., in Carthagena 40.5%; Cephaeline in Rio 25.9, Carthagena 56.8%. Recent examination of Carthagena infers a larger proportion of Emetine or of some other base of high molecular weight.—Evans Anal. Notes, 1912. See also H. R. Jensen, P.J. i./16,519.

Extractum Ipecacuanhæ Liquidum (Off.).

The separation of the total alkaloid into emetine and cephaeline by Paterson's process would exclude the use of Carthagena Ipecacuanha. The cephaeline should not exceed 30% of the total.—B. & C.D. i./05,403.

Ten Cc. of Liquid Extract are evaporated in a flat basin with 5 Cc. of $\frac{N}{1}$ Acetic Acid and 10 Cc. of Water to 5 Cc. Twenty Cc. of water are added with 5 Cc. Acetic Acid and the resinous matter broken up and removed by filtering through a pledget of cotton wool into a cylinder. The capsule is washed with 10 Cc. water and 1 Cc. Acetic Acid. To the cold mixture is added 1 Cc. liquor ferri dialysatus (1885), the whole made up to 50 Cc., well shaken and set aside to separate.

Twenty-five Cc. are filtered off into a separator, mixed with excess of Ammonia and 20 Cc. of equal volumes of ether and chloroform, well agitated, warmed and set aside to settle. This extraction is repeated with another 20 Cc. of ether and chloroform mixture. Other two extractions are made with 10 Cc. of chloroform, which gives a more complete extraction. The bulked liquids are distilled off and the residue dried at 80° C. until weight is constant.

The weighed residue is dissolved in excess of N/10 HCl and back-titrated with N/20 NaOH, using tincture of cochineal as indicator.—W. B. Cowie, P.J. i./13,433. 1 Cc. N/10 HCl = 0.02865 Gm. combined or mean of emetine and cephaeline according to new formula (Vol. I., pp. 512 and 519).

Tschirch recently found the P. Hung. assay method best. Shake 5 Gm. of powdered root in a well corked Erlenmeyer flask with Ether 75 Gm. for 15 minutes. Add 4 Cc. of 10% Ammonia Solution and shake well for 15 minutes further. Set aside 15 minutes, then filter off 60 Gm. (= 4 Gm. of root) into a 200 Cc. stoppered flask. Distil off the solvent to dryness. The residue is twice treated with 5 Cc. of Ether and the Ether evaporated each time. On cooling, 30 Cc. of ether saturated with water and 10 Cc. of N/10 solution of hydrochloric acid are added. After solution has been effected, add 90 Cc. of water and a few drops of solution of iodeosin. Shake and set aside for five minutes, agitating gently from time to time. Titrate with N/10 solution of sodium hydroxide until the aqueous layer assumes a faint rose tint. The difference between the amount of Cc. of N/10 solution of hydrochloric acid and N/10 solution of sodium hydroxide solution multiplied by 0.0241 indicates the amount of alkaloids present in 4 grams of powder.—C.D. '20,1371.

Vinum Ipecacuanhæ.

The amount of true alkaloids (volumetric) used in compounding this preparation might fall as low as 0.07%, though the amount put into it must be 0.095 to 0.105% (gravimetric).

The B.P. uses sherry, and the tannin content will cause precipitation of the alkaloids. The B.P. makes no suggestion as to alkaloidal strength, and the assay method used for the liquid extract cannot be properly applied in the case of the wines.

Titration of the alkaloids in the assay of the liquid extract is better than gravimetric method.—H. R. Jensen, P.J. i./16,518.

Emetine Bismuth Iodide. Du Mez's analysis indicated the formula Em.5HI.BiI_3 . We doubt the accuracy of this formula.—c.f. Vol. I., p. 516.

Adsorbed Emetine made by means of **Aluminium Silicate** found

effective in stopping the excretion of cysts and free from the gastric irritation common with Emetine Bismuth Iodide. A similar Cephaeline compound was found to be irritant.

Adsorption Compounds of Opium alkaloids, with Hyoscyamine, Quinine, Acriflavine, etc., had been made.—H. R. Jensen, B.P. Conf., 1920.

JABORANDI FOLIA.

P. Microphyllus is largely used in making pilocarpine and is official in U.S. if yielding not less than 0.6% alkaloids.

FR. CX. directs *P. Jaborandi* to be used, but states that *P. Pennatifolius* is much employed. It states further that *P. Microphyllus* Stapf. (Maranham Jaborandi) is esteemed by manufacturers on account of its high alkaloid content, but is the most adulterated.

P. Pennatifolius, *P. Selloanus*, and *P. Trachylophus* are substitutes and differ from the leaf as described in B.P. '98.

P. Trachylophus contained as much as 0.75%.—Southall's Lab. Rep.

P. Racemosus.—Jowett and Pyman obtained Pilocarpine Nitrate=0.12 per cent. of the leaves but no other crystalline constituent (contrary to previous workers).—Proc. Chem. Soc., 1912, 28, 268.

Pilosine.—A new alkaloid from *P. Microphyllus*—from the mother liquors after separating Pilocarpine and Iso-pilocarpine. Content 0.007%.—Proc. Chem. Soc., 1912, 29, 267.

Pilocarpinæ Nitras.

For an aqueous solution of 2 Gm. in 100 Cc $\alpha_D = +82.2 @ 18^\circ \text{C}$.—FR. CX. Pure Pilocarpine Nitrate melts at $177-178^\circ \text{C}$. **Isopilocarpine Nitrate** (the salt of an isomeride and conversion product of Pilocarpine) melts at 159°C . P.J. i./97,466; i./04,54. That in U.S. melts at 170 to 173°C . FR. CX. 177°C

Detection of Pilocarpine and Quinine in Toilet Preparations.

—The relative solubility of Quinine Chromate and insolubility of Pilocarpine Chromate is used.—P.J. ii./12,317.

JALAPÆ RESINA.

Power made various Extractives of Jalap Resin—with petroleum, ether, chloroform, ethyl acetate, and alcohol—all of these excepting the first produced purgation of dogs. He concludes that none of the amorphous bodies obtained from Jalap should have chemical formulæ assigned to them.—P.J. ii./09,7.

The ether test for scammony was devised to detect the adulteration with jalap. Scammony resin of commerce is obtained from the roots and not from the gum resin. American Scammony called 'Orizaba Jalap Root' (*Ipomœa orizabensis*) is used as the source of the resin.—P.J. ii./05,583.

Numerous older references in previous editions.

LECITHIN.

Lecithin is a Mono-amino Phosphatide. Phosphatides are complex bodies of more or less fatty nature which can be extracted from tissues by Alcohol, Ether, etc., and which contain fatty acids, Nitrogen and Phosphorus. They are of unstable composition.

On hydrolysis Lecithin yields Stearic Acid, Glycerophosphoric Acid and Choline.

Lecithins may be derivatives of either Stearic, Palmitic, or Oleic Acid alone or mixed. Ove-¹lecithin is generally assumed to be mainly Stearyl, i.e., **Choline-distearo-glycerophosphate**, and plant Lecithin to be mainly an Oleic Acid body, but the fatty Acids are not determined with certainty.

Lecithin Content of Various Substances in percentages—

Brain	16.0	Egg Yolk	12.0
Heart	4.5	Peas	1.2
Liver	4.3	Lupin Seeds	2.0
Kidneys	8.5	Ergot	1.7
Lung	1.5	Yeast (dry)	2.0
Spinal Cord	11.0	Barley	0.7
Nerve Tissue (dry)	17.0	Wheat and Rye	0.6
Blood Corpuscles.. ..	0.46	Green Peas	0.15
Mushrooms	0.9		

Examination of Lecithin.

From numerous experiments which we have made both on products of our manufacture **from fresh egg yolk** and on samples obtained from other makers, we recommend the following as tests for purity:—

(1) 1 Gm. should be soluble in 10 Cc. of Alcohol 90%, leaving only a negligible residue not exceeding 2.5%. 1 Gm. dissolved in 10 Cc. of Alcohol should not require more than 0.5 Cc. of N/1 Sodium Hydrate to neutralise (Phenolphthalein).

(2) All the Nitrogen should be present in the form of Choline, *i.e.*, it should be Alcohol soluble.

(3) The total Phosphorus should be estimated. Lecithin should be entirely soluble in Chloroform indicating absence of added mineral Phosphates.

If the **Cadmium compound of 'Lecithin'** (the Cadmium Chloride method is the usual method of purification) is recrystallised from a mixture of Ethyl Acetate and 80% Alcohol the true lecithin can be freed from **Kephalin** and then liberated from its Cadmium compound by means of Ammonium Carbonate.—*Abst. Ann. Rep. Chem. Soc.* 1919 (Vol. XV.), p. 161.

(4) The ratio of Phosphorus to Nitrogen should be approximately 2 : 1.

Phosphorus should be 3.5—3.7%.

Nitrogen should be 1.9—2.0%.

Iodine Value should be 60—65%.

Lecithin, Determination of in Preparations.—Extract 1 to 2 Gm. of a Lecithin preparation or 5 to 20 Gm. of a food stated to contain it with 96% Alcohol—first in the cold and then twice under a reflux condenser. Then extract the insoluble portion with boiling Chloroform 2 hours. The combined Alcohol and Chloroform extractives are evaporated and the residues are digested two hours with 100 Cc. Chloroform to separate the Lecithin from Phosphoric Acid, Glycerophosphoric Acid, *etc.* To estimate Phosphorus Pentoxide in the purified extractive incinerate and oxidise with Sulphuric and Nitric Acids or ignite with Magnesium Oxide and bring to weight as Pyrophosphate in the usual manner. The factor 11.36 is used to convert the amount found of P_2O_5 into Lecithin.—*J.S.C.I.*, 1913, 32, 307, per Y.B.P., 1913, 36.

LITMUS, CUDBEAR, ORCHIL and TURNSOLE.

Litmus. *Syn.* **Lackmus** (German) is a blue pigment obtained from *Rocella tinctoria* (*Discomyces*). Employed chiefly as an indicator for respectively acid and alkali as Litmus Paper, also in form of solution in Volumetric analysis. Litmus is made in Holland by fermenting lichens in presence of ammoniacal liquids and potash.

LITMUS SOLUTION (B.P. Appendix, 1898).—Boil litmus 2 with alcohol 90% 8 for 1 hour, pour off clear liquid, repeat with 6 and again with 6. Digest the litmus thus washed in distilled water 20, and filter.

In titration, all CO_2 must be removed by boiling before taking end reaction. Not suitable for weak bases. Quinine, Morphine and Strychnine are neutral to it and the acids in their salts can be titrated as if base were absent.—*P.J.* ii./o8, 194

Carbon Dioxide only turns Litmus "wine red" when alkaline bicarbonates are present as impurities, otherwise it turns red just like any other acid.—*Na.*, Aug., 1911, p. 215.

Kubel and Tiemann's Litmus Solution, a modification of the above, is sometimes used. It is prepared as follows:—Extract 30 Gm. powdered Litmus with 500 Cc. of Distilled Water at 80° C., add Acetic Acid in excess. Evaporate on a water bath to a thick extract. Extract with 100 Cc.

90% Alcohol, then add 50 Cc. more of the same spirit, twice in succession, to remove precipitate from dish. Mix the whole and filter. Wash the filter well with the Alcohol. Dissolve the residue in the filter in distilled water at 70° C., and dilute to 250 Cc.

LACMOID, also known as **Resorcin Blue**, is chiefly Diazo-Resorcin. Solution 0.2% in Dilute Alcohol employed as indicator closely resembles Litmus in reactions. —P.J. ii./o8,194.

Azolitmin. Manufacture. Extract coarsely powdered litmus 100 Gm. three or four times with hot water. Evaporate the hot filtrate to 200 Cc. Add Hydrochloric Acid (conc.) 20 Gm. and dialyse until Hydrochloric Acid-free. The dialysate (Azolitmin solution) is remarkably sensitive. To isolate the colour evaporate the solution to small bulk, precipitate with alcohol, allow to deposit, collect and dry well at moderate heat. It is soluble in water especially on adding a *trace* of alkali.

Cudbear. *Syn.* Red Indigo.

A purplish red powder obtained by the ammoniacal fermentation of *Lecanora tartarea* and other lichens, designated in Germany *Persio*, in France *Orseille de terre*.

The name "Cudbear" is from "Cuthbert," the baptismal name of Dr. Gordon, who in 1777 understood the management of the manufacture of this dye-stuff (for which he was the patentee) at Leith, and named it after himself. —C.D. i./13,451.

Excepting for the fact that it is in the condition of a fine powder it is virtually the same article as Orchil.

Tinctura Persionis.—P.J. i./o7,352. Percolate Cudbear 2½ ounces with 1 pint of a mixture of 90% alcohol 1, and water 2. Used as a colouring agent acids increase the red and alkalis change to purple.

Cudbear, the Examination of.—Orcein is not so useful in Pharmacy as Cubbear.—Am. Jl. Ph., Aug., 1912.

Archil *Syn.* Orchil.

The word Archil or more properly Orchil was originally the name of the plant from which the dye which goes under the name is obtained. It appears that before the introduction of Archil into this country a similar dye obtained from certain lichens in Scotland was in use under the name "Cork." This is given in Miller's "Plant Names" (1884) as the name of the lichens yielding Archil.—C.D. i./13,451.

It is made from various lichens, *e.g.*, *Roccella*, *Lecanora*, etc. The lichens are ground up and fermented with addition of stale urine or ammonia. Its production is similar to that used for Litmus except that the Potash is omitted. In commerce it is usually in the form of a pasty mass known as **Archil** (French, *Orseille en pate*).

Turnsole (Fr. Tournesol).

Daniel Hanbury, in a short paper on the subject, P.J. 1850, 9,308, did much to clear away the mystery regarding the use of this substance, *i.e.*, the colouring of the familiar Dutch cheeses.

The word has been more particularly applied to a product from *Crotophora tinctoria*, A. Juss (Croton *Tinctorium* Linné)—a native of Southern Europe and the Orient. Rags soaked in the juice of this plant are exported to Holland. They change colour on exposure to Ammonia vapour, and this purple colour can be extracted with water for the purpose in question.

Turnsole, by some of the early writers, was supposed to form the colouring matter of litmus (which is not the case, *vide* "Litmus"). Indeed the name may have been associated with Litmus in order to conceal the true nature of this and the U.S.D. XVIII. Edn. and the N.S.D., give Tournesol incorrectly as synonymous with and equivalent to Litmus—for further details *c.f.*, P.B. Powers' Lecture on D. Hanbury, P.J. ii./13,489; C.D. ii./13,514.

PERFUMES OF LICHENS.—In addition to their inherent perfumes lichens have considerable utility as basis of Pot Pourres.—E. M. Holmes, P R., Dec., 1913.

MAGNESIUM.

Magnesium metal may prove dangerous in certain conditions, *e.g.*, when powdered and mixed with an equal quantity of Silver Nitrate and a drop of water added. Slight explosion with flash may occur. With Mercuric Nitrate there is vigorous reaction, brown fumes rise but no flash.—*Na.*, Nov. 9/11.

Magnesium and Palladious Chloride together in certain proportions will cause water to decompose at ordinary temperature.—*Chem. News*, May. 31, 1912, 253; *P.J.* ii./12, 75.

Magnesia Mixture for estimation of Phosphates.

Solution of Magnesium Ammonio-Sulphate. Dissolve Magnesium-Sulphate 20, Ammonium Chloride 40, in Water 160, add Ammonia Solution 84. Allow to deposit in stoppered bottle before use. Employed for the gravimetric estimation of phosphates. Ammonium Magnesium Phosphate is precipitated and converted by incinerating into Magnesium Pyrophosphate $Mg_2P_2O_7 = 222.64$.

Talc. A native Magnesium Silicate also Kaolin (Aluminium Silicate) have been used recently as substitutes for Bismuth in gastric and intestinal affections. Talc is insoluble and not affected by acids. In diarrhœa of phthisis upwards of 200 Gm. *p.d.* Does not constipate like bismuth. *Dose.* —‘Spoonfuls’ with water, milk or emulsified with gum. Best on empty stomach. *Jl. des Praticiens*, June 26/20, per *Pr.*

MALTUM.

Extractum Malti.

Assay of Malt Extract.—Our experiments show that the following is a reasonable standard of purity, that under the conditions specified 0.5 Gm. of Malt Extract shall convert its own weight of arrowroot in 20 minutes (*Umney*). This we have found to work satisfactorily. Proceed as follows:—

(a) Mix Bermuda Arrowroot 1 Gm. with Water 100 Cc., boil 10 minutes, and when cold make up to 100 Cc.

(b) Dissolve Malt Extract 5 Gm. in water *q.s.* to produce 100 Cc.

(c) Tincture of Iodine 1 Cc. with water *q.s.* to 50 Cc.

¶ Warm 50 Cc. of (a) in a flask on the water bath to 100° F. Add 10 Cc. of (b) also at 100° F., mix and keep at this temperature for 20 minutes. Remove 4 Cc. of the solution and add 1 Cc. of (c). There should be no evidence of unconverted starch.

Estimation of Diastasic Power.

The resulting Dextrose may be titrated with Fehling’s Solution, 1 Cc. of this = 0.005 Gm. Dextrose = 0.0045 Gm. of Starch converted thereinto.

A properly prepared Malt Extract contains Maltose as its principal ingredient. Glucose and Dextrin are sometimes added as sophistications, and the Protein content is consequently lowered—the latter should be about 6% of the whole, or 8% of the total solids.

The Malt Extracts of Commerce are reported on the total reducing sugar found being calculated as Maltose; the Protein was arrived at from the total nitrogen found. The **Diastasic Power** was expressed as the percentage of Starch digested by the Extract in half an hour at 40° C., *i.e.*, a Diastasic Power of 500 means an extract digesting five times its weight of starch. The percentage of Maltose in the same varied from 53.6 to 75.2, and the Diastasic values from 9 to 413. —*B.M.J.* ii./09, 1477; i./10, 30.

Some of the preparations are referred to in our Patent Medicine Chapter

The late E. F. Harrison assayed Malt Extract by determining the amount of Maltose produced from a given weight using Anhydrous Potato Starch 1 Gm. in Water 100 Cc. with 0.2 Gm. Malt Extract. After half an hour at 40° C. the Maltose formed is titrated. If the Diastasic Power is over 500 repeat the test using less Malt Extract. Glycerin is a frequent addition and might be approved of for an Official preparation to extent of 5% by volume. Proteins might be 5% at least. A lower figure for Protein would point to added Glucose or other non-nitrogenous matter

Description of **KJELDABL'S** research on the measurement of diastastic power. The action of diastase he showed was influenced by amount of the malt extract present, the temperature of the experiment, the length of time of digestion and the concentration of the solution.—A. R. Smith, P.J. ii./10, 362.

'Diastasic' to indicate the nitrogenous principle, produced during germination of Barley, capable of disintegrating the Starch Molecule, is more correct than 'diastatic'—C. H. Fielding, P.J. ii./10, 312, 333.

Adulterants.—The principal adulterants found were materials containing dextrose, *e.g.*, starch, syrup and molasses-syrup (from beet sugar). The dextrin formed in mashing of Malt is never much less than 10% of the Maltose formed. The amount of dry solids is determined, the amount of sugar reckoned as Maltose, and the proportion of Nitrogenous substances. If the two latter are added together and deducted from the total dry solids, the result is the amount of non-reducing Nitrogen free Extract, which is practically speaking dextrin, and the figure is called the dextrin figure, usually 9 to 14. If below the minimum one can conclude adulteration with glucose or starch syrup, because the dextrose of these has a much greater reducing power than Maltose. Maltose produces less acidity, *i.e.*, less irritation to the bowels. 70% of Maltose is absorbed in the first hour, whilst only 20—40% of other Sugars. Addition of glucose reduces protein content and the organic phosphorus. The food value of Malt Extract depends directly on its diastasic strength.—Max Hamburg—P.J. ii./09, 133.

Incompatibility of various Chemicals with the Diastasic Power of Malt Extract.

Experiments were conducted on lines somewhat analogous with those carried out in the case of Pepsin and Pancreatic Ferments (*q.v.*). Average doses (with some exceptions) of a selected list of the chemicals concerning which the information would prove of value, were mixed with 600 Cc. approx. (actually 24 ounces) of an Arrowroot Mucilage 1% strength and then 30 Cc. (1 ounce) of a 20% malt extract added and the mixtures kept at 100° F. for 30 minutes and examined at 15 and 30 minutes respectively for unconverted starch.

In the following list + indicates complete conversion of the starch—*i.e.*, such chemicals are compatible with the Diastase of Malt in conditions approximating those occurring *in vivo*. — indicates Incompatibility.

Effect of Certain Chemicals on Malt Diastase. (+ Indicates Compatible.)

CHEMICAL.	AMOUNT USED.	EFFECT AFTER 15 MINUTES.	EFFECT AFTER 30 MINUTES.
Acetonum	5 Cc.	+	+
Acid Aceto-Salicylicum	0.6 Gm.	—	partial
„ Benzoicum	0.6 Gm.	+	+
„ Boricum	0.6 Gm.	+	+
„ Carbolicum	0.2 Cc.	+	+
„ Coumaricum	0.6 Gm.	+	+
„ Gallicum	0.6 Gm.	partial	+
„ Hydriodicum	0.6 Cc.	partial	+
			(only just so)
„ Hydrobromicum	2 Cc.	—	—
„ Hydrochloricum	0.6 Cc.	—	+
„ Hypophosphorosum	0.5 Cc.	—	—
„ Phosphoricum Dil	0.6 Cc.	partial	+
„ Sulphurosus	2 Cc.	—	—

CHEMICAL.	AMOUNT USED.	EFFECT AFTER 15 MINUTES.	EFFECT AFTER 30 MINUTES.
Acid Salicylicum	0·6 Gm	—	—
„ Tannicum	0·6 Gm.	—	—
Ammonii Carbonas	0·5 Gm.	+	+
Caffeinæ Citras	0·3 Gm.	partial	just
Caffeinæ Sodio-Salicylas	0·3 Gm.	+	+
Calcii Glycerophosphas	0·3 Gm.	+	+
Calcii Hypophosphis	0·3 Gm.	+	+
Chloral Hydras	0·6 Gm.	+	+
Chloroformum	0·6 Cc.	+	+
Creosotum	0·2 Cc.	+	+
Cupri Sulphas	0·06 Gm.	—	+
Fel Bovis	0·6 Gm.	+	+
Ferri et Ammonii Citras	0·5 Gm.	+	+
„ Perchloridi (Liquor)	0·6 Cc.	—	+
„ Sulphas	0·2 Gm.	+	+
Formalin	0·06 Cc.	+	+
Glucose	15 Cc.	+	+
Glycerinum Pancreatis	3·5 Cc.	+	+
„ Papain	2 Cc.	+	+
„ Pepsin	4 Cc.	+	+
„ Trypsin	4 Cc.	+	+
Glycerinum	8 Cc.	+	+
Guaiacol	0·2 Cc.	+	+
Hydrargyri Perchloridum	0·0025 Gm.	+	+
Hydrargyri Iodidum (with Potas- sium Iodide)	0·0025 Gm	+	+
Hexamethylenetetramine	0·6 Gm.	+	+
Hydrogenii Peroxidum 10 vols.	4 Cc.	+	+
Liquor Donovanii	0·6 Cc.	+	+
Lithii Citras	0·5 Gm.	+	+
Magnesii Sulphas	4 Gm.	+	+
Manganesii Hypophosphis	0·5 Gm.	+	+
Paraldehydum	2 Cc.	+	+
Piperazin	0·6 Gm.	—	—
Potassa Sulphurata	0·3 Gm.	—	+
Potasii Bicarbonas	1·2 Gm.	+	+
„ Bromidum	1·2 Gm.	+	+
„ Chloras	0·6 Gm.	+	+
„ Hypophosphis	0·25 Gm.	+	+
„ Permanganas	0·12 Gm.	—	—
„ Tartras Acidus	2 Gm.	partial	+
„ „ Neutrale	4 Gm.	+	+
„ Iodidum	0·6 Gm.	+	+
Phenazonum	0·6 Gm.	+	+
Pyramidon (note this alone gives a Violet with Iodine)	0·3 Gm	+	+
Phosphorus	0·0013 Gm.	+	+
Quininæ Hydrochlor	0·3 Gm.	+	+
„ Bi- „	0·3 Gm.	+	+
Sodii Nitris	0·06 Gm.	+	+
Syrupus Eastoni	2 Cc.	+	+
„ Ferri Iodidi	2 Cc.	+	+
„ „ Phosphatis	2 Cc.	+	+
Terpinol	0·2 Cc.	+	+
Thymol	0·1 Gm.	+	+
Tylmarin	0·6 Gm.	+	+
Zinci Bromidum	0·12 Gm.	+	+
„ Sulphas	0·12 Gm	+	+

The following gave—in *stronger proportion*, viz., average dose in only 150 Cc. (5 ounces) of the fluid the effects indicated:—

CHEMICAL.						AMOUNT USED.	EFFECT AT 30 MINUTES.
Acid	Aceto-Salicylicum	..	..	..	..	0·6 Gm.	—
„	Benzoicum	..	..	..	..	0·6 Gm.	—
„	Gallicum	..	..	..	..	0·6 Gm.	—
„	Hydriodicum	..	..	..	..	0·6 Cc.	—
„	Hydrochloricum	..	..	..	..	0·6 Cc.	—
„	Phosphoric Dil	..	..	..	..	0·6 Cc.	—
Caffeinæ	Citras	..	..	..	..	0·3 Gm.	—
Glycerinum	Pepsini	..	..	..	..	4 Cc.	—
Cupri	Sulphas	..	..	..	..	0·06 Gm.	—
Ferri	Perchloridi Liquor	..	..	..	..	0·6 Cc.	—
Potassa	Sulphurata	..	..	..	..	0·3 Gm.	—
Potassii	Tartras Acidus	..	..	..	..	2 Gm.	—
Syrupus	Eastoni	..	..	..	..	2 Cc.	—
Zinc	Bromidum	..	..	..	..	0·12 Gm.	partial
„	Sulphas	..	..	..	..	0·12 Gm.	—

It will be seen therefore that the following in general are **incompatible** with Malt Diastase.

Acids,—various Inorganic and Organic, and Acid preparations; Ferri Perchloridum, Pepsin preparations, Piperazin, Potassii Permanganas.

And that a very large number of substances which might have been expected to have decided inhibitory action on the ferment are *compatible* and may be prescribed simultaneously when required. *c.f.* also Enzyme Action, Vol. I. p. 631.

Free Ammonia (not included in our list) is stated to inhibit Malt Diastase.

MEL DEPURATUM (Off.).

The honey of commerce melted on a water bath and strained hot. Now directed “to be adjusted to Sp. Gr. 1·36 if necessary.”

P.G.V. gives the following tests.—An Aqueous Solution (Honey 1 and Water 2) should have Sp. Gr. of at least 1·11. It should yield only slight precipitates with Silver Nitrate and Barium Chloride, and on mixing with an equal volume of Ammonia should not at once change colour (*foreign colouring matter*). 5 Cc. of the Solution treated with a few drops of Concentrated HCl must not turn pink or red (*Azo colours*). 15 Cc. of the Aqueous Solution warmed on a water bath and treated with 0·5 Cc. of Tannin Solution (1 in 20) and filtered—1 Cc. of the cold filtrate (clear) on addition of 21 drops of Fuming HCl and 10 Cc. of Absolute Alcohol should not turn milky (absence of *Starch mucilage* and *Dextrin*).

For neutralisation 10 Gm. of Honey after diluting with 5 volumes of water shall require at most 0·5 Cc. N/1 KOH using Phenolphthalein as indicator—(Test for *rancid honey*).

Honey on incineration should yield not less than 0·1 or more than 0·8% residue (*Invert Sugar and Starch*).

U.S. IX. gives the following:—

If 1 Gm. of Honey be triturated with 20 Cc. of ether in a mortar and filtered and the filtrate be allowed to evaporate and 1 drop of a 1% resorcin solution in Hydrochloric Acid be added, a pink colour may form which disappears in half a minute, but an orange, cherry or brown-red colour is not produced. (*Artificial or added invert sugar*.) The Sulphuric Acid test quoted in our last edition is no longer included in the U.S.

Morphine *see* Opium.

NITROGLYCERINUM.

Assay of Nitroglycerin in Solutions and Tablets.

Pure fused Potassium Nitrate 0.722 Gm. is dissolved in Distilled Water, *q. s.*, to 1,000 Cc. and used as standard. One Cc. of this solution contains 0.0001 Gm. Nitrogen in form of Nitrate—thus 1.2 Cc. will contain the same amount of Nitrogen as $\frac{1}{100}$ grain of pure Nitroglycerin. If an Alcoholic Solution be the subject of analysis the equivalent of 0.00065 Gm. ($\frac{1}{100}$ grain) of pure Nitroglycerin (calculated) is measured out and allowed to evaporate spontaneously in a dish and in another dish 1.2 Cc. of the standard is measured and evaporated at a low heat. When both are dry 2 Cc. of Phenol-disulphonic Acid Reagent are added to each—both are well stirred and left 10 minutes, diluted with water, rendered slightly alkaline with KOH and diluted to 100 Cc. or less in Nessler tubes and compared. For Tablets, 5 tablets are powdered, dissolved in 10 Cc., filtered and 2 Cc. of the filtrate (or equivalent of $\frac{1}{100}$ grain) treated as above.

Phenol Di-Sulphonic Acid Reagent.—Heat Phenol 3 Gm. with Sulphuric Acid 37 Gm. in a flask on a water bath at or near 100° C. for 6 hours—Sutton's Volumetric Analysis.

We have found the method to give concordant results with Alcoholic Solutions of Nitroglycerin, but it is not suitable for the Tabellæ as made by the writer.

NUTRIMENTA.

Foods may be classified as follows:—

- 1. Proteins.** (*a*) free and (*b*) combined.
 - (*a*) These include the Albumins and Globulins and the results of proteolysis of these, viz., Albumoses and Peptones.
 - (*b*) These contain Hæmoglobin, which is an albuminous compound with a complex iron body; Glycoproteins, which are compounds of proteins with carbohydrates; Nucleoproteins, which are compounds of proteins and Nucleic Acid, which latter is an organic compound of Phosphoric Acid.

The decomposition of proteins produces the nitrogenous extractives, *i.e.*, Urea, Purin or Alloxuric bodies, such as Xanthin, Hypoxanthin and Uric Acid, Creatin and Creatinin.
- 2. Fats.** This group of proximate principles of the tissues, is represented by the glycerides. triolein, tripalmitin and tristearin (*v.p.* 142). Here is to be included also Lecithin, which on hydrolysis yields glycerophosphoric acid and Choline—the latter is an alkaloid allied to Neurine, and when in excess is a sign of nervous tissue degenerating and will produce toxic symptoms when existing in quantity in excess of the amount which can be oxidised into urea.
- 3. Carbohydrates.** These may be in part decomposition products of the proteins and in part material about to be dealt with by the bioplasma, they are Monosaccharides, $C_6H_{12}O_6$ (Glucose, Galactose and Mannose), Disaccharides $C_{12}H_{22}O_{11}$ (Cane Sugar, Milk Sugar, and Maltose), Polysaccharides $(C_6H_{10}O_5)_n$ (Glycogen, Starch, and Cellulose).* They are

* NOTE.—Importance of removing Carbohydrate matter from the teeth. Many organisms in the mouth ferment, Carbohydrates producing chiefly Lactic Acid. MONOSACCHARIDES are the most readily fermented. DISACCHARIDES require to be first inverted to MONOSACCHARIDES by an enzyme formed by certain of the mouth organisms before Lactic Acid can be produced. STARCHES require a double inversion—the first stage brought about by ptyalin or organisms before fermentation to an acid can occur. Formulæ are given showing that 1 mol. $C_6H_{12}O_6$ (glucose) produces 2 mols. Lactic Acid; 1 mol. of the Disaccharide Cane Sugar $C_{12}H_{22}O_{11}$ + 1 mol. H_2O gives 1 mol. each Dextrose and Lævulose, with ultimate formation of Lactic Acid; and that the polysaccharide $(C_6H_{10}O_5)_n$ (Starch) + H_2O = $C_6H_{10}O_6$ Dextrin + $C_{12}H_{22}O_{11}$ Maltose, which Maltose is converted into 2 mols. Dextrose, and ultimately to Lactic Acid. The Lactic Acid dissolves the lime salts of the enamel and a cavity is originated at the point of action.—B.M.J. 1./09,396.

all converted into glucose in the body, whilst they are also stored up as glycogen or animal starch pending metabolism in the liver, muscles &c.—“Nutrition and Malnutrition.”—Allchin, L. i./05,1111.

Biuret Reaction.

This reaction is one of several general reactions for albuminoid substances

It is used in particular to recognise Urea, which heated in a capillary tube until the melted Urea is distinctly turbid and dissolved on cooling in water with a few drops of Soda Solution added, gives, on adding a drop of dilute Copper Sulphate Solution, a red to violet colour, which turns to blue on further addition of the Copper Solution.

To obtain good results with the test in the recognition of Protein, the test solutions of Albumin, Copper Sulphate and Sodium Hydrate are best of following strengths:—Albumin in Distilled water 0.2%, Sodium Hydrate 1 Gm. in 10 Cc., and Copper Sulphate 5 Gm. to 100 Cc. water. Limits of delicacy both with this and cold Nitric Acid are given.—Bio. Chem. Jl., Vol. IV.; L. ii./09,302.

Proteins, Nomenclature of. Desirability for revision. I. ‘Proteid’ should be rejected. II. ‘Protein’ is recommended. If used at all the word ‘Albuminoid’ to be viewed as a synonym of Protein. III. The sub-classes to be protamines, histones, albumins, globulins, sclero-proteins, phospho-proteins, conjugated proteins, derivatives of proteins, polypeptides. IV. The term ‘Caseinogen’ to be used for the principal protein in milk and Casein for its derivative,—the result of action of rennet. V. The two principal proteins of the muscle plasma to be called paramyosinogen and myosinogen,—soluble myosin to take the place of v. Färth’s soluble myogen fibrin. The term myosin to be restricted to the final product formed during rigor mortis.—L. i./07,672; P.J. i./07,288.

For further remarks on the Classification of Proteins, *vide* Allen.

The hydrolysis of Proteins gives glyocoll, alanine, leucine, etc.—amido-acids. Fischer, starting with glyocoll, synthesised 100 bodies closely allied to peptones,—he designates them ‘polypeptides’—the work gives biology a clearer insight into the chemistry of animal and plant life. Synthesis of enzymes is also possible.—P.J. i./07,260; Am. Jl. Ph., April, ’07,168.

AMIDO-ACIDS. Syn. AMINO ACIDS.—These are very important constituents of Proteins. They are acids containing the Amido (NH_2) group. It has been suggested that all proteins are derived from Aspartic Aldehyde by condensation. They are both basic and acidic, *e.g.*, the following:—

Carbamic Acid NH_2COOH . (Amido-formic Acid.)

Glyocoll $\text{NH}_2\text{CH}_2\text{COOH}$. (Amido-acetic Acid.)

Sarkosin $\text{CH}_3\text{NHCH}_2\text{COOH}$. (Methyl-glyocoll.)

Alanine $\text{CH}_3\text{NHCH}_2\text{COOH}$. (Amido-propionic Acid.)

Leucine $\text{CH}_3(\text{CH}_2)_3\text{CH}(\text{NH}_2)\text{COOH}$. (Amido-caproic Acid.)

Aspartic Acid $\text{HOOCCH}_2\text{CH}(\text{NH}_2)\text{COOH}$. (Amido-succinic Acid.)

Glutarmic Acid $\text{HOOC}(\text{CH}_2)_2\text{CH}(\text{NH}_2)\text{COOH}$. (Amido-glutaric Acid.)

Tyrosine $\text{HO.C}_6\text{H}_4\text{CH}_2\text{CH}(\text{NH}_2)\text{COOH}$. (Hydroxyphenyl-amido-propionic Acid.)

Taurine $\text{NH}_2\text{CH}_2\text{CH}_2\text{SO}_3\text{H}$. (Amido-ethane-sulphonic Acid.)

At the moment of death proteins change in composition. Dead proteins consist of a mixture of Amido-Acids.—Tibbles.

The complex molecules of the Proteins have been found to be built up of a number of comparatively simple fractions which can exist independently and which, widely as they differ in structure have in common that they belong almost without exception to the above group of Amido Acids. Some of these fractions are occasional constituents of the excreta, *e.g.*, leucin, tyrosin cystin in which last the Sulphur of Proteins resides. From others the equally familiar excretory products, or products of putrefaction are derived,—such as Indol from tryptophane, cadaverin from lysin and putrescin from arginin.—Sir A. E. Garrod.—B.M.J. i./11,1413.

Pathology and treatment of diabetes mellitus. Three lectures dealing principally with the physiology of diabetes. Several Diabetic Foods are shown to contain a large proportion of Carbohydrate as starch—these constitute source of great harm. As to drugs something is wanted to set metabolism right in the way that Thyroid Extract acts in myxœdema—but a strong believer in Opium and some of its derivatives.—Pavy.—L. ii./08,1499, 1577, 1727

Further remarks by Halliburton on.—L. i./09,21.

Estimation of Amino-Acids in the Urine *vide* p. 374.

Protein metabolism during starvation and after giving Milk protein.—*L. i./14,236.*

Diets, effects of various, and the resistance of animals to certain poisons.

Investigations by Reid Hunt showed by use of Acetonitril CH_3CN , which decomposes into HCN in the body that animals (guinea pigs and mice) when permitted an increased power of oxidation liberate more Hydrocyanic Acid; on the other hand when in a state of partial inanition the intensity of the process of oxidation is lowered, consequently less Acetonitril is decomposed and the animal is rendered more resistant to the poison.

Dextrose, oatmeal, liver, kidney and thyroid gland increased the resistance of mice to the poison. The influence of Iodine compounds and of various articles of diet is due to the power of stimulating the function of the thyroid gland. Certain diets (notably eggs, milk, cheese and various fats) greatly lower the resistance of certain animals to Acetonitril,—their effect is the opposite of that of thyroid. **The Pharmacological action of acetonitril** renders it useful for such investigations. Most ordinary poisons undergo no marked changes before exerting their toxic effects. Acetonitril, however, is, according to general views, poisonous only or largely as a result of formation from it of Hydrocyanic Acid. Formation of Hydrocyanic Acid is due to certain processes of metabolism which may be modified by drugs and diet,—processes of oxidation (by which the Methyl group is oxidised to Formic Acid) are probably involved.

The results of the experiments indicate that there are factors entering into the composition of foods,—more complicated than its Protein, fat and carbohydrate composition and suggest lines of research to find means of increasing resistance of the body to the poisons of disease. Hygienic Lab., Bulletin No. 69, June, 1910.—U.S. Public Health and Marine Hosp. Service, Washington, 1910, v. also *B.M.J.* ii./10,1270.

Aceto-nitrile as a test for thyroid and further feeding experiments.—*P.J. i./14,534,599.*

Food requirements for Sustenance and Work.—

A working man working hard with his muscles will expend about 3,000 calories.—*P.J. i./15,886* (see also 'Standard Requirement,' p. 97).

The energy demanded by men undertaking a forced march of 25 miles under severe climatic conditions being 5,000 calories (this is calculated on a formula adapted from Zuntz's work—800 of which calories are furnished by Protein and 1,800 by Starchy Biscuit food) in what form should the remaining 1,400 be furnished?—Melville advocated for soldiers on active service a diet on the following lines:—Proteins 150 Gm. in the form of cheese and leguminous vegetables, Carbohydrates 600 Gm., Fats 150 Gm., and sugar in the form of jam. He points out that the lack of fat is a serious matter when preserved meat is issued. The proportion of fat to meat in fresh meat is about 1 to 4, but in corned beef this is reduced to 1 to 10. A good form of fat ration is cheese, but lard or suet are also suitable, also a mixture of sugar and jam in equal parts forms an excellent and most sustaining diet.—*B.M.J.* ii./10,1337.

With regard to Chittenden's statement that "a daily metabolism of 0.10—0.12 Gm. of Nitrogen per kilogram of body weight is quite adequate for physiological needs, provided a sufficient amount of non-nitrogenous foods is taken to meet the energy requirements of the body,"—this holds good for those leading a sedentary life such as the Bengalis.—*B.M.J.* ii./10,1341;

CALORIE VALUES OF FOODS.

Hutchison gives the following figures (Calories) as indicating the true worth to the body of the different nutritive constituents as sources of potential energy; Protein 4.1, Carbohydrates 4.1 and Fat 9.3 Calories. Proteins, carbohydrates and albuminoids seem to be oxidized quickly in the tissues, fats more slowly. Therefore, if a rapid output of energy is required, the first group will be more serviceable whereas a slow production over a long time will be equally well met by fat.

Method of Applying the Calorie Standard. Multiply the percentage of protein or carbohydrate (or both), that the food contains by 4.1 and the percentage of fat by 9.3 to obtain the total Calories yielded by 100 parts of the food in question.

Standard amounts of the different nutritive constituents required daily. Protein 120 grammes, Carbohydrates 500 grammes, Fat 50 grammes. These would yield a total of 3,007 Calories. Such a standard may be regarded as suitable for a man of average build and weight, doing a moderate amount of muscular work; if a greater intake of energy is demanded it should be met by increasing the amount of fat consumed.

Total Calorie Value of the Ration of the British Soldier is calculated to be 4,500 to 5,000 calories.—B.M.J. i./16,345.

Calorie Values of some proprietary food preparations.

(Except where indicated the Calorie value is between 3·7—3·9).

Allinson's (Dr.) Natural Food.	Granose.
Avenola 3·92.	Grape Nuts.
Chapman's Food.	H.O. (Hornby's Steam cooked Oat-meal) 3·94.
Cheltine Food.	Hygiama 4·25.
Dubarry's Revalenta Arabica Food 3·68 (Consists of Lentil Flour).	Nut Bromose 5·10.
Emprote.	Roborat (73% Protein).
Eustace Miles' Breakfast Food.	Stamina Food.
Gluten Meal (either pure gluten or a mixture containing 30% of this).	Winter's Prunus Perfect Food 5·17.
	For full details see B.M.J. i./10,1239.

The above Calorie Values are calculated from the percentage composition and represent the kilo calories yielded by complete combustion of 1 Gm. of each cod. For comparison are given the—

Calorie Values (Kilo calories) of a few common foods.

Milk 0·70.	Coarse White Bread 3·03.
Potatoes 0·98.	Fat Beef 3·27.
Lean Beef 0·98	Peas 3·31.
Eggs 1·59.	Lentil Flour 3·55.
Cheese 2·4.	Fat Mutton 4·03.
Fine Wheat Bread 2·74.	Butter 8·60.
Wholemeal Bread 2·78	Bacon 8·86

—Hutchison's Food and Principles of Dietetics.—

B.M.J. i./10,1239.

The above commonly accepted *standard of daily food* requirements in adults as prescribed by Atwater and Voit (Protein 120 Gm., Fat 65 Gm., Carbohydrate 500 Gm.), is thought to be unduly high. Chittenden, for example, says 80 Gm. or less Protein is enough. Investigation into the food requirements of children—to provide nutritious food at small cost.—Chalmers Watson, B.M.J. i./13,603.

One pound of **Raisins** contains 1,635 food units of energy, the same as three dozen **Eggs**. One pound of **Beans** contain less than half as much food value, one pound of **Peas** less than one third, one pound of **Potatoes** and one pound of **Milk** together fall 925 points short. Even one pound of **Beef** fails to equal it by 1,055 food units.—'A Patriot,' P.J. i./15,825,886.

Horlick's Malted Milk Lunch Tablets. Total large calorie value of a tin probably about 450. The following figures were obtained, but they do not include all:—

Protein from total Nitrogen	..	..	15·4 Gm. × 4·1 = 63·1
Fat	..	..	7·8 Gm. × 9·3 = 72·5
Reducing Sugars	..	..	59·7 Gm. × 41 = 244·8

(Abstd., B.M.J. i./16,345).

380·4

Yeast Extracts as Food.

Yeast extracts, *c f.*, our Vol. I., p. 274, have been made and substituted for meat extracts; a test has been published for detecting this substitution. P.J. ii./03,516,704; *vide* also Y.B.P. 1907,101.

The test is based on the fact that Meat Extract contains both creatine and creatinine, whilst Yeast Extract contains neither. The "Lancet" (i./07,1505) thought the test to be a conclusive one if carried out satisfactorily. We have tried the test on Yeast Extract and a well-known brand of Meat Extract and must confess we obtained brownish red colours with both—difficult to distinguish one from the other;

Providing they are correctly labelled, **Yeast Extracts** may be quite good and wholesome in their way. They are practically identical in composition with Meat Extracts and similar in taste. Their presence in Meat Extracts can sometimes be determined microscopically by observing yeast cells. Diluted Fehling's Solution on being brought to the boil after adding a quantity of the Aqueous Solution of the extract to be examined shows a bulky curdled precipitate of greenish grey colour if yeast extract be present.—P.J. ii./11,72.

Experiments have shown that dogs assimilate 87.2% of the Nitrogen in the yeast. The slight bitter taste of fresh yeast can be removed by treatment in the cold before drying with Sodium Carbonate.—P.J. ii./11,448.

Liquid foods, according to recommendation in America, should contain at least 8.8% solid constituents, and should possess at least as much nutritive power as milk. One-fourth of it, exclusive of Alcohol and Glycerin, should be in the nitrogenous matter. The protein matter should be converted by pepsin or pancreatin—not by acids.—L. ii./07,308.

Nucleic Acid of Yeast compared in its chemistry with Thymus-Nucleic Acid. The resemblance between Nucleic Acids and **Phosphatides**.—Abst. Ann.Rep.Chem.Soc.1919 (Vol. XV.) p. 157.

ACCESSORY FOOD FACTORS. VITAMINES.

The following gives some information additional to that provided in Vol. I., p. 577 *et seq.* :—

An examination of the Phospho-Tungstic Acid precipitate from an Alcoholic Extract of **Rice Polishings** showed considerable amounts of Choline and Nicotinic Acid in the polishings, and Betaine, Adenine, Guanine and possible Guanidine were detected. Drummond and Funk failed to isolate the curative substance. They think it is decomposed during the fractionation process.—Bio. Chem. Jl. abst., L. i./15,193.

The substance or substances in rice polishings and in unpolished rice preventing beri-beri are soluble in Alcohol and are decomposed by Sodium Hydrate. Experimental proof.—H. Fraser & A. T. Stanton, L. i./15,1021.

Proprietary Infants' Foods are thus classified :—

1. Foods with a basis of dried cow's milk but mixed with flour.
2. Foods consisting mainly of flours, the starch of which is practically unaltered or altered only by heating.
3. Foods consisting mainly of flours mixed with a proportion of malt flour or malt extract, but containing much unaltered starch which is not converted into soluble products during the process of preparing the food for infants in accordance with the directions given on the package.
4. Foods containing flours, but also containing active diastase or pancreatic ferment, so that if the food is carefully prepared according to the directions on the package the starch is appreciably altered.

5. Foods manufactured from flours, the starch of which has been mainly or partially converted into soluble products during the course of manufacture.

The observation is made that most proprietary foods are deficient in fat and also in fat-soluble factor, whilst a number are also stated to be inadequate with respect to the water-soluble factor, and all are deficient in the anti-scorbutic factor.—From Med. Res. Com. Report, per C.D. Feb. 14, '20. See also Roy. Soc. Med. Discussion, L. i./20,604.

In **Dried Milk** there is a risk of losing the antiscorbutic factor (C).—B.M.J. i./20,580.

Accessory Food Factors in infant feeding. Experimental rickets in dogs.—E. Mellanby, L. i./20,856.

Savory & Moore's Food is stated to contain the active enzymes and vitamins of malt. It contains no dried milk. In preparing it for use it is not heated sufficiently to impair vitamins or enzymes. When so prepared it approximates mothers' milk.

Monkeys fed on autoclaved food and killed and intestines examined show marked difference from normal.—R. McCarrison, B.M.J. i./20,249.

Rationing of troops requires extreme care in direction of providing sufficient vitamins. Outbreak of scurvy in the Indian troops in Macedonia was a severe lesson.—W. H. Willcox, B.M.J. i./20,73.

Lipochrome pigments in relation to fat-soluble accessory food factors.—O. Rosenheim and J. C. Drummond, L. i./20,862,874.

Lemon Juice Experiments by Heating.—Prof. Bassett-Smith, L. ii./20,997.

Marmite (Yeast Extract) contains Vitamines. They are absent in Meat Extract. Apart from this fact, there is no available information to show that Meat Extract is better or *vice versa*.—A. Chapman, P.J. i./19,115.

Cotton-Seed Meal "injury"—decline of animals fed on cotton seed—is not due to lack of water-soluble vitamine. Animal experiments show most characteristic symptoms to be emaciation, loss of appetite, weakness, etc., finally coma and perhaps paralysis.—Jl. Pharm. and Exp. Therap., Dec. 1920.

Hæmoglobin.

Defibrinated Blood and Globin Solution in treatment of Cancer.—

Experiments by H. C. Ross ('Induced Cell-Reproduction and Cancer,') showed that *in vitro* cell division is "directly caused by certain constituents of the soluble remains of dead tissues." In the neighbourhood of old healing ulcers the Hæmoglobin is evidently decomposed,—as the Hæmatin produced in consequence collects as insoluble pigment. When Hæmoglobin decomposes thus into Hæmatin and Globin the former is insoluble in water, except in presence of dilute alkalis. Globin is stated to be readily soluble,—hence this substance (if either of the two) is thought responsible for causing proliferation. A saturated solution of Hæmoglobin on prolonged boiling precipitates the Hæmatin and gives a straw-coloured filtrate which, on evaporation, when reaching saturation point about 4%—becomes deep red. Globin is a protein not precipitated by boiling, decomposing on keeping and giving off a foul smell.

Ross employed this saturated solution at Liverpool in chronic callous ulcers of the leg (simply applied with a little sterile gauze)—granulations set in rapidly and in 20 hours marked effect was seen. Globin has also been used dried in small pieces 'dotted' on to the ulcerous surface,—this causes extensive proliferation of the epithelium from the sides of the ulcer, but suppuration is likely to occur, even if the dried Globin is prepared with aseptic precautions. Scabs form which have to be removed with fomentations and the process repeated. A mixture of powdered Globin 5 with Kreatin 2 has also been used and produces more marked proliferation.

This investigation, according to Ross, affords proof that the '*cell proliferation of healing can be caused by the chemical auxetics Kreatin and Globin.*'

Prevention of Proliferation—Normal Blood Serum has the power of preventing the 'natural' auxetics from inducing cell division (Bashford & Murray showed that serum has the power of restraining the growth of secondary transplanted tumours in mice). Bashford and others also showed that transplanting living growths in mice protect same to some extent against cancer. "It was considered possible that this might be due to the fresh augmented auxetic produced by the transplanted growths giving rise to increase in content of restraining body." Hence a **process of treatment of cancer patients** was devised by injecting them with augmented auxetic combined with Blood Serum,—**6 ounces of defibrinated sheep's blood being given per rectum** every morning. This serum contains the restraining body, and it was thought that the red cells would be destroyed in the rectum, the Hæmoglobin would be decomposed and in time the Globin would become augmented by the action of bacteria present. It was thought that the restraining body of the serum, the auxetic in the globin and in the remains of the white cells, and the products of decomposition would be gradually absorbed and that they might raise the content of the restraining body in the patients—in other words act as a sort of vaccine. Several cases were treated on these lines—in some with apparent benefit.

Solution of Globin for rectal use has been made by boiling Hæmoglobin of commerce (*i.e.*, Oxyhæmoglobin) and removing the Hæmatin, subsequently adding a small quantity of Sodium Carbonate. This has been prepared 5% strength approx. in 'Globin.' 1 molecule of Hæmoglobin is understood to yield two molecules of Globin (the molecular weight of this body being probably about half that of Hæmoglobin)—and 1 molecule of Hæmatin (the molecular weight of which is minute in comparison).

Globin is a histonc. **Histones** are proteins intermediate between protamines and albumens. When oxyhæmoglobin is treated in aqueous solution with dilute acids or alkalies, or when the solution is warmed to 64—69° C. it breaks up into hæmatin and globin.—Allen, 4th Edn., Vol. VIII., 33.

BREAD AND FLOUR STANDARDISATION.

Flour Bleaching and Harmful Baking Powders.

The 'Standard Bread' agitation attracted considerable attention early in 1911. We gave the matter most thorough consideration in our previous editions, and we still maintain that the Standardisation of Food is *as important as*, if not *more important*, than the standardisation of Drugs. We see no reason for greatly altering what we then said on the matter, excepting perhaps to reiterate its importance and to lay stress on the fact that much of the flour sold in this country is of an *exceedingly poor quality*, with little nutritive value. We incline strongly to the view that poor grades of flour are bleached and otherwise chemically treated to render them white and attractive in appearance. Inferior flour can in this way acquire a higher commercial value. ***Bleached Flour is prohibited by law for sale in the U.S.A., but it is we understand exported for sale here.***

Dr. J. M. Hamill's Food Report No. 14, 1911, to the Local Government Board, on the nutritive value of bread made from different varieties of wheat flour gave a useful résumé of the nomenclature of various milling products, *e.g.*—

'Wholemeal' or 'Graham Flour' (actually whole grain flour).

'Entire Wheat Flour' or 'Fine Meal'—a product obtained by removing a portion of the bran and grinding the rest of the grain. (This includes so-called "Standard" Flour).

'Households'—The commercially lower grade of flour obtained from roller mills—it is darkish in color.

'Patent Grade.'—Commercially the higher grade flour produced by roller mills. It is better color than any other grade of flour produced in the mill.

'Straight run' or 'straight grade'—intermediate in appearance and quality between households and patent grades.

Special flours, prepared from any of the above usually with the object of improving nutritive qualities.

This report should be read by those making a study of the subject.

The author (W.H.M.) communicated a paper on the so called Standard Bread to the "Chemist and Druggist" (C.D. i./11, Index Fo. 321) which forms the groundwork to this article. Abstracts from papers by a number of Authorities on Dietetics who have since from time to time written on the subject of "Standard" bread, its advantages and disadvantages, have been incorporated.

The "manifesto" by some of the highest medical authorities defined "Standard" bread as *bread made from unadulterated wheat flour containing at least 80% of the whole wheat including the germ and semolina.*"

A glance at a sectional diagram of a grain of wheat, *e.g.*, as shewn in the above Food Report or on p. 266 in Jago's "Science and Art of Breadmaking" shows the situation of the "germ" (a small portion of the entire grain) in the grain and enables one to understand the reason why it is in great measure winnowed away by the roller process of milling. The husk, or outer envelope yields the bran, and consists roughly of cellulose and salts; the endosperm yields the starch, the germ is rich in protein and fat. With regard

to the above definition of "Standard Bread," the word "Semolina" might as well have been omitted for the reason that it may refer to the most various products according to the fancy of the miller. The semolina obtainable commercially is the hardest portion of the endosperm of the wheat grain and is obtained in a granular form by adjusting the rollers sufficiently far apart, so as not to crush the granules. It is usually prepared from the hardest wheats, *i.e.*, those grown in Southern Europe. The modern roller mills convert the wheat into flour and "offal." Entire Wheat Flour is obtainable from the old fashioned mill stones, or by the roller mills. The germ differs considerably in composition from other parts of the grain. We have placed side by side (from W. Jago—transposed from his figures into percentages) the amounts of certain constituents of a (a) wheat mixture, (b) one of the semolina products—that coming from the second and third "breaks," (c) "Flattened Germ" from the same mixture and (d) Bran:

	Wheat.	Semolina.	Flattened Germ.	Finished Bran.
Moisture ..	38.171	43.041	14.822	22.598
Soluble extract ..	16.403	13.577	43.940	17.567
Soluble protein ..	4.361	3.191	15.652	2.259
Crude gluten (dry)	19.093	19.416	—	—
Ash ..	4.835	3.394	5.501	12.742
Phosphoric Acid	2.465	0.747	3.207	7.322
Fat	4.993	4.311	11.982	3.068
Cellulose ..	9.671	12.627	4.776	34.4

Note the figures for "Soluble Extract," Protein, "Ash," Phosphoric Acid and Fat in the Germ in comparison with Wheat, also the figures for Ash and Phosphoric Acid of Bran compared with those in wheat.

With regard to the mineral constituents in the ash of wheat and other cereals:—Lime (Allen, 3rd Edn., 1898, vol. 1, p. 447) ranges from 1 to 10%; Magnesium Oxide gives an average of 12.11%; Silica rarely reaches 5%, being usually less than 2%, P_2O_5 constitutes an average of 49 to 50%. Iron as Fe_2O_3 averages 1.1%.

We are fully aware that these figures *may* have no value and that it is possible to twist the data into meaninglessness, also that figures giving flour analyses vary with every authority (*c.f.* Atwater and Benedict, Hutchison, Tankard, etc.).

With regard to **bread-making** it may be mentioned that wheat and rye are the only suitable cereals—owing to the fact that they contain the protein "*gluten*" which becomes viscid on mixing with water—hence forming the dough. Gluten is developed by interaction in the presence of water of the two proteins gliadin and glutinin. We are indebted to Nature, May 4/1911, p. 313, for the following remarks.

The outer coats of the grain yield bran, fine pollards, sharps, and middlings, the germ is removed as offal, while ordinary flour is derived almost solely from the endosperm. The flour itself is divided into a larger portion, "bakers" or "households," and a smaller, very white and poor in protein, known as "patents," from which genuine Vienna bread and the best class of fancy breads and pastries are made. The semolina, derived from the central parts of hard wheat, and rich in gluten, is also lacking in white flour.

It will thus be seen that ordinary white flour and white bread made therefrom contain little or none of the bran, germ, and semolina, and valuable food

constituents—mineral matter and protein of the bran and semolina, and fat and protein of the germ—are lost. Wholemeal bread is therefore richer in the nutritive constituents and has more flavour, but is darker in colour than white bread, owing partly to the inclusion of the bran and partly to an interaction by which dextrin and sugar are formed which undergo darkening in the oven. Wholemeal bread is, however, apt to be irritating on account of the cellulose and silica of the outer coat, but by removal of the outer layers of the husk the irritant material may be excluded, and the valuable mineral, protein, and fatty constituents of the inner branny coat, semolina, and germ, retained. Such a flour constitutes the “80 per cent. flour” employed in making the so-called “standard” bread. The term “80 per cent. flour” means that a wheat, a bushel of which weighs 64 lb., yields 80 per cent. flour. In the old method of milling, the wheat is ground between stones, the flour being separated by sifting, and in this way some of the “offal” is retained: hence the term “stone-ground.”

There is doubtless some difference of opinion as to the relative values of ordinary and “standard” flour, and the bread made therefrom. The roller mills cleanse the wheat in a very efficient manner. Chemical analysis, except as regards salts, shows little difference between the two; “standard” bread may even be slightly poorer than ordinary bread in protein, owing to the greater percentage of moisture.

Leonard Hill and M. Flack (B.M.J. i./11, 1068) reported on rats fed for three weeks, some on standard bread and some on white bread, and for a second three weeks on white and “standard” flour. The result was astonishing. Of the rats fed on white bread and flour ten died, while only five died of those fed on “standard” bread and flour. The survivors of the latter lot increased in weight $27\frac{1}{2}$ per cent. against 12 per cent. for those fed on white bread. Another lot fed on white flour *plus* an amount of wheat germ about equal to that in standard flour, gave results quite as good as for “standard” flour.

In a second note they express the opinion that the State should use all its powers to make wholemeal bread the food of the children of the poor (and ? those also who are commonly classed as not poor.—W. H. M.). The whole meal is the real staff of life and no saving of trouble or liking “a nice looking loaf” should be the pretext for taking away substances essential for the growth of children. It was found that rats can thrive and be reproductive on wholemeal and water. A diet of white flour and water is more harmful to young rats than old. Germ and bran are needed above all for growth.—B.M.J. i./11, 1311.

In a third article they state “standard” flour proved better than wholemeal used in their previous work,—the reason being that the wholemeal previously used contained only a portion of the sharps and bran—their removal gave it a nutritive value higher than the true wholemeal, probably because this contains too much cellulose. Hovis Flour contains about 20% of germ. This is separated in the milling by being rolled flat. After screening off it is sterilised and added to white flour. Wholemeal contains about 1 to 2% of germ, 13% of sharps (the inner husk) and 15% of bran. The addition of 20% of germ increases the percentage of protein and insures the presence of the organic Phosphorus compounds essential to growth. The feeding experiments on rats show the *great importance of the germ of which white flour is robbed*.—B.M.J. ii./11, 598.

They have shown that rats, mice and pigeons cannot be maintained on white bread and water, *but can live on whole meal or on white bread in which an extract of the sharps and bran in sufficient amount is incorporated*. Bearing on this it is pointed out that a diet of white bread, or polished rice, and tinned food, sterilised by heat, is the cause of beri beri, *i.e.*, demonstrating the importance of certain active principles in the outer layers of wheat, rice, etc. and in milk, meat, etc., which are destroyed by heating to 120°C .—B.M.J. ii./12,601.

W. Tibbles thinks rodents unsuitable animals for the experiments. Cellulose is a *sine qua non* of proper nutrition to them. There is no doubt whatever about the great nutritive value of the proteins in the germ, but its removal (which is done for the sake of color and keeping qualities) does not rob the bread of much protein. *The total proteins of the grain average 12%,—distributed thus—endosperm 8.925, germ 0.538, aleurone 2.048, episperm 0.178, cuticle 0.362%. The germ is, however, rich in Nitrogen, i.e., 6.44% including 0.8% Amide Nitrogen* (the germ forms, of course, a very small proportion of the entire grain). He holds, B.M.J. i./13,25, that the presence of the cereal and germ in the flour really increases the total percentage of Nitrogen and Phosphorus very little.

With regard to the **Phosphorus** in wheat bran,—this was first thought to be inorganic—then to be connected with the nuclein or salts of Nucleic Acid—but researches show that only 33% of the Phosphorus could be accounted for in this way and that the chief Phosphorus compound is a Magnesium-Calcium-Potassium Salt of a Phospho-organic Acid,—probably identical with Anhydro-oxy-methylenc-diphosphoric Acid,—an acid which is widely distributed in the vegetable kingdom.—B.M.J. ii./11,861, 1137.

The higher animals are apparently not endowed with power of preparing their own organic phosphorus compounds from inorganic phosphorus, nor indeed, are they probably able to form such compounds of one group from those of another. These bodies are of far-reaching importance to the bioplasm.

It is probable that over sterilisation of preserved meats (*e.g.* temperature of 120°C .) causes deficiency of organic phosphorus.

Rickets has become so common—by comparison—with the German child that in Germany it is called the 'English Disease'—it is less common in the Highlands and in Ireland. The Highland child gets oatmeal containing 0.9% P_2O_5 , mainly in *organic* combination. The Irish child gets probably fresh milk and butter (1% P_2O_5) in addition to potatoes which contain a fair amount of Phosphorus near the skins. Light and air may have a good deal to do with protecting both these from rickets. The German child gets rye bread; in this the organic phosphates are evenly diffused throughout, and even fine rye bread contains sufficient (1% P_2O_5) of these compounds. He does not suffer from rickets so much as the English child, whose diet is apt to consist largely of *skim milk, margarine* (0.03% P_2O_5), and *white bread* (0.2% P_2O_5)

—all notably deficient in organic phosphates. At present we use the phosphates of the wheat and rice as food for our prize cattle.—B.M.J. i./II, 1421.

A healthy man accustomed to a full mixed diet requires for maintenance of phosphorus equilibrium about 1.5 Gm. of phosphorus, or nearly 3.5 Gm. of Phosphoric Acid per diem; the organic combination seems to be the best. The calcium requirement is equivalent to about 0.7 Gm. of Calcium Oxide *per diem*.—Na., Dec. 1, 1910, p. 148.

W. Tibbles writing again says: "In addition to the Cellulose, the **Amino-Acids** (**Asparagin, Leucin and Tyrosin**) are of importance. It is to the greater amount of these in the germ and cercalin that one may look for the different effects obtained by feeding with flours of various grades.—B.M.J. ii./II, 1137.

In a further note L. Hill and M. Flack write: "*Wheat germ alone added to white flour* makes this an adequate food on which animals can live healthily. This proves that the lack of Cellulose has nothing to do with the insufficiency of white flour, and that whatever the active principle may be, it is present *no less in germ than in bran and sharps*. In fact, rats did better on white flour plus germ than on white flour plus sharps, bran, and a trace of germ.—B.M.J. ii./II, 1330.

Robert Saundby communicated a paper on food and feeding which bears on the subject (B.M.J. i./II, 1218). The following is an abstract from this communication:

The public were asked to adopt the view that 'white bread' is deficient in nitrogen and inferior to bread made from flour containing the whole of the constituents of the grain. **Wholemeal or Graham Flour**.—No objection can be made against white bread so long as this is not due to chemical bleaching. (For the subject of bleaching *vide* later). It must contain weight for weight as good proportions of protein, carbohydrate, mineral matter and fat as the 'standard' article. An undesirable effect of the agitation was the unloading of large stocks of inferior flour (*Truth*, April 12, 1911, p. 207). The **moisture** in bread varies from 30 to 40%. In Columbia, U.S.A., the proportion is regulated by law to 31%, but here there is *no legal limit*. Excess of gluten produces a loaf that retains moisture. Beri Beri (*vide* also *Vol. I.*, pp. 814, 824, *Vol. II.*, p. 467) is associated with eating completely shelled rice. Accessory Food Factors are removed in the 'polishings' which are of great importance, and similar conclusions may be drawn in the case of white flour. It has been brought forward that DENTAL CARIES is attributable to the softness of white bread, but 'standard' bread is just as soft, and the natives of South Africa, India and Japan, subsist on soft starchy foods and have good teeth. Caries is more likely to be due to excessive consumption of sugar, which rose from 30 lb. per head in 1864 to 89 lbs. per head in 1910. The importance of doing away with hand labour for machine-made bread is strongly urged

in the interests of hygiene and health. A baker is stated to lose 200 to 340 Gm. in weight while kneading a batch of bread, mainly in perspiration, part of which certainly enters into the dough.

The therapeutic value of FASTING is carefully considered in this paper. Disappearance of or amelioration of many chronic ailments in Rome after fast has been proved; prison diet has been shown to have similar effect. A fasting day from time to time in treating diabetes has been proved of value and so on. There is no doubt as to the high nutritive value of oatmeal and porridge.

Increase in acidity of Bread during Mastication.

Hill and Flack conducted some experiments on this subject. They did not find any marked difference between the acidity produced on masticating white and wholemeal breads (it has been said that decay of teeth is due to acid production from white bread). Thomas Read writes: "It would appear as if the ferments from the wheat germs in the wholemeal bread used by Leonard Hill had been injured before bread making—then both breads would form acid in the same way in mastication. If the ferments in the 'Standard' type have not been injured before baking, the conversion of starch into grape sugar takes place during bread making, and no acid is formed during mastication. If, on the other hand, the flour does not contain the ferments of the wheat germs or they have been injured no conversion of starch into grape sugar takes place during bread making, and when the bread reaches the mouth the ptyalin of the saliva converts starch into grape sugar and bacteria in the mouth convert this freshly formed sugar into lactic acid which decays the teeth."—B.M.J. i./11,1456.

W. A. Bond pointed out that *flour of the 'Standard' type must contain more protein, fat and ash, than fine white flour made from the corresponding wheat or mixture of wheats.* He suggested a standardising method based on the presence of a substance of the nature of Phytin, also a minimum of protein, etc.—L. i./11,1669.

Benjamin Moore writes "*anent the Phospho-protein in the sub-pericarpal layers of grain,*" that this is a glucoside—possibly galactosan. These glucosides are known as hemi-celluloses and are termed pantosans and galactosans according as they yield a pentose or galactose on hydrolysis. Polyneuritis established in fowls by feeding on polished rice can be combated by a daily ration of an alcoholic extract of the rice meal from the separated pericarpal layers, containing only 0.16 mgr. of Phosphorus Pentoxide and 4 mgr. of nitrogen.—B.M.J. ii./11,1137.

A strong plea for the retention of the wheat germ. Its removal (as in the old white flour) diminishes food value. Millers freely contest the view and are in favour of *white* flour. *Maize* should be prohibited. The oil it contains is indigestible.—Sir F. Fox, B.M.J. i./17,591.

The above information should be considered with the latest theories on *Vitamines*, for details of which see Vol. I., p. 577, and this vol. p. 98.

Bleaching of Flour.—

‘Waste and Over-Eating’—An excellent ‘Leader’ appeared in the B.M.J. i./15,214, from which we take the following:—The bleaching of and faking of flour give opportunity for the millers to form rings and force the prices up. Bread is sold legally by weight, and too often the baker slack-bakes his loaf and leaves as much water in it as possible; in consequence it is less digestible, more dough-like and less nourishing. Bread ought to be sold as containing a given weight of the food principles found in wheat, not less than so much protein, so much carbohydrate, and containing all the principles which suffice to support the nutrition of pigeons when they are fed on bread and water.

The bleaching of flour by chemical process is unnecessary. It is safe to say that if the ‘Standard Bread’ agitation did nothing more than rouse those in authority to the necessity of stopping bleaching, its work was rewarded.

The United States Government in 1910 took action against certain flour millers in regard to 625 sacks of flour which were alleged to be adulterated, and after trial the Government authorities proved their case and the flour was condemned. It had been bleached by the ‘Alsop’ process. “The essential apparatus in this process is a small chamber with two electrodes. One of these electrodes is stationary; the other is raised up and down by a suitable crank motion, so as to approach the first. These electrodes are charged with a heavy current of electricity. When the points of the electrodes touch, the current flows just for a second, and when they are pulled apart a flaming discharge takes place between the two. This discharge is of a high temperature—so much higher than the ordinary temperature of combustion that it causes the nitrogen and oxygen in the air to combine, actually to burn, and the result is **nitrogen peroxide**. While the electrodes are in operation, a current of air sweeps out the nitrogen peroxide, and a further supply of air is drawn in. After being swept along, the nitrogen peroxide is carried by a tube to a box, which is provided with a rotating apparatus. To this box, called an agitator, comes the finished flour from the mill, and is made to fall down through the nitrogen peroxide and air. During this passage the bleaching is effected.”—From a bulletin on the case by the U.S. Dept. of Agriculture.

The result of this process is that the flour contains an appreciable amount of nitrites. The physiological effect of this flour has been described as ‘disastrous’ in the case of many persons who eat bread made from it.

To this criticism we would add further criticism. What we say is that the Bleaching of Flour should be an *unnecessary proceeding and should not be tolerated*.

In a Local Government Board Report (Food Report No. 12, 1911) Drs. J. M. Hamill and G. W. Monier-Williams dealing with the action of **Nitrogen Peroxide** (N_2O_4) (in quantities up to 300 Cc. per 1 kilo flour) indicate that the color of the bleached flour may change again, *i.e.*, become yellow or still more bleached according to circumstances. The quantity of Nitrous Acid or Nitrites formed is proportional to the N_2O_4 used. The N_2O_4 is present in the flour as **Nitric** and **Nitrous Acids** or **Nitrates** and **Nitrites**. In highly bleached flour (1 kilo with 300 Cc. of N_2O_4) an increase in the amounts of soluble Proteins and soluble Carbohydrates takes place. The amount of soluble Nitrogen is doubled (due entirely to the solubility of Gliadin in HNO_3 of certain strengths). About 6 to 7% of the Nitrogen introduced as N_2O_4 —is absorbed by the fat of the flour—it undergoes change like an oxidised oil. The rate of digestion was greatly retarded if the starch had been previously treated with N_2O_4 . *Bleaching exercised an inhibitory effect on the salivary digestion of flour.*

In commenting on the above report the "Lancet" (L.i./II,1024) says—steps taken by other countries, *e.g.*, Australia, U.S.A., and Switzerland, to banish by statute the practice of bleaching should be a useful object lesson to the legislators of this country. (Though not allowed for sale in the United States *there is nothing to prevent millers in U.S.A. from exporting bleached flour.*—L. ii./II,1045). The process cannot be viewed as free from risk to the consumer—especially in regard to the inhibitory effect on digestive processes and enzymes. Many millers are unaware of the nature and composition of the improvers they add. *The whole practice is conducted to make an inferior article attractive.*

B.M.J. i./II,881, also gives some very complete abstracts of these Reports. The commercial aspect has a humorous side as is shown by the following:—

'Some millers are at present only deterred from installing bleaching plants by consideration of expense. Others have had plants installed but have discontinued using them, in some cases for the reason that they were unwilling to pay the patentees for permission to use the process.' There is a possibility that the anti-bleach agitation may have been initiated by an interested miller.

The Local Government Board issued a further report on "**The Nature of the Colouring-matter of Flour and its Relation to Processes of Natural and Artificial Bleaching.**" G. W. Monier-Williams shows herein that the colouring-matter is either carotene or a substance closely allied to it. The colour of this body is discharged by oxygen or by nitrogen peroxide. On exposure to the air it is bleached by absorption of oxygen, no oxides of nitrogen being absorbed, and it is reasonable to assume that the natural ageing of flour is a similar process, while in the bleaching of flour by nitrogen peroxide substances are produced which are not produced during the natural ageing of flour. Unbleached flour contains some nitrite reacting substance, but this is equivalent to not more than 1.5 to 2 parts of sodium nitrite per million; the effect of excessive bleaching on the baking qualities of flour is dealt with. As much as 158 parts of sodium nitrite may be present in a million

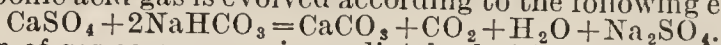
parts of bleached flour which contained 0·5 parts before bleaching, and that bread made from it contained 75 parts sodium nitrite per mill. The report contains spectroscopic diagrams illustrating detection of colouring matter and the effect of bleaching upon it.—C.D. ii./12,751.

A reply to the anti-bleach proposition states that Nitrites do not interfere with the action of diastase on starch, also that pancreatic digestion is not inhibited by relatively large quantities of Nitrites. Further, that direct experiments with the compound of the colouring matter of the flour with oxides of nitrogen showed that this is not poisonous nor does it have any perceptible action on the blood.—J.C.S.I., Jan., 1912, p. 40.

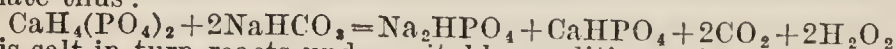
Calcium Sulphate in Baking Powder and Self-raising Flour.

Baking Powders, according to a L.G.B. Report on 'the presence of Calcium Sulphate in Baking Powder and Self-raising flour' (Food Report No. 13, 1911, by Dr. Hamill), in use in this country are conveniently classed into two groups (1)—this being far the larger—tartaric powders in which the acidic constituent is tartaric acid, cream of tartar, or a mixture of these, and (2) the phosphate powders, the acidic constituent of which is acid calcium phosphate, together with sodium bicarbonate in all cases. Ammonium carbonate is extensively used *per se* as a necessary ingredient in the baking of sponge cakes and other light bread products. Alum is not now employed, although it is capable of acting as an acidic constituent, and was formerly much used. In an addendum by C. H. Cribb, regarding the use of phosphate baking powders and the alleged utility of calcium sulphate in them, it is stated:

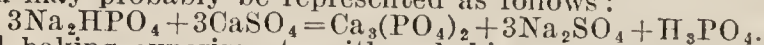
When calcium sulphate is mixed with sodium bicarbonate in the presence of water, carbonic acid gas is evolved according to the following equation:—



The evolution of gas commences immediately, but is very slow, so that at the end of $\frac{1}{2}$ an hour 59 per cent. and after one hour 79 per cent. of the theoretical quantity was found to have been liberated, and even after three hours the reaction was not complete. When acid calcium phosphate acts upon sodium bicarbonate one of the products of the reaction is hydrogen disodium phosphate thus:



and this salt in turn reacts under suitable conditions with calcium sulphate, giving rise to phosphoric acid, which in turn can liberate a fresh quantity of carbon dioxide from any carbonate which may be present. The first part of the reaction may probably be represented as follows:



In actual baking experiments with a baking-powder containing calcium sulphate, 75 per cent. of the calcium sulphate was recovered unchanged from the finished loaf. Other experiments would seem to indicate that the calcium sulphate which has disappeared as such in the loaf is again re-formed by the agency of the acid in the gastric juice when the bread is eaten.

Calcium Sulphate occurs in commercial acid calcium phosphates to the extent of 2 or 3 per cent. up to 50 per cent. The proportion varies according to the method of preparing the calcium phosphate.

It is generally made from bone ash by means of phosphoric and sulphuric acid. When commercial phosphoric acid only is added to the bone ash, a product can be obtained containing as little as 2 per cent. or as much as 9 per cent. of calcium sulphate. When sul-

phuric acid alone is used, the product may contain as much as 50 per cent. of calcium sulphate; mixtures of these acids give values intermediate between the extremes mentioned. It is also stated that calcium sulphate is sometimes deliberately added as a diluent. In order to keep the acid phosphate and sodium bicarbonate from too intimate contact, a neutral non-hygrosopic powder, known as 'filling,' is added, such as corn flour or rice flour, the last-named being generally preferred. The filling commonly forms about one-half of the baking powder, but in cheaper powders this is exceeded. The following recipes are given in the report:

Calcium Acid Phosphate	..	..	50	..	37	..	2	..	77
Sodium Bicarbonate	..	..	25	..	23	..	1	..	41
Maize Starch, rice-flour or ground									
rice	..	..	25	..	40	..	3 to 10	..	50 to 100

From $\frac{1}{2}$ oz. to 1 oz. of baking powder is employed for each pound of flour, hence if the calcium acid phosphate of the first powder contained 50 per cent. of calcium sulphate, $\frac{1}{2}$ ounce of the powder would contribute over 50 grains of calcium sulphate to the flour. The same remarks apply in regard to the calcium sulphate introduced with the phosphate, 70 grains per lb. being contained in the above flour if the first ingredient is 50 per cent. phosphate. The phosphate baking powders are said not to keep well and are not found in retail trade so much as among confectioners and bakers, who mix the ingredients when required, and so avoid deterioration. Self-raising flours are made according to the following formula:

Calcium acid phosphate	..	..	..	6 lb.
Sodium bicarbonate	..	..	..	3 lb.
Flour	..	..	..	280 lb.

Dr. Hamill makes the following recommendations (*inter alia*):

(a) *Manufacturers of acid phosphates* should not prepare even their cheapest qualities of acid phosphate, for sale as food ingredient, in such a way that it contains more than 10 per cent. of calcium sulphate.

(b) *Bakers, self-raising flour makers*, and others using acid phosphate in the preparation of food, should limit themselves to acid phosphate of high commercial quality—calcium sulphate not to exceed 10 per cent.—L.G.B. Report and Editorial comment C.D. i./11, Index Fo. 545.

Added Mineral Substances.—

'Improvers' in form of Acid Potassium Phosphate, or Acid Calcium Phosphate or even Phosphoric Acid enables the miller to use a larger proportion of cheap wheats in blending, etc., and introduces more water into the bread. These improvers may be contaminated with Arsenic and in any case their addition is not in order. Flour contains its phosphorus in organic not inorganic form.—P.J.ii./11,71.

Section 3 of the **Sale of Food and Drugs Act, 1875**, provides that no person shall mix any article of food with any ingredient or material to render it injurious to health.—c.f. L. i./12,842.

Detection of Potato Starch in Bread.—Moisten a small piece of bread crumb, crush to a paste on a slide under a cover glass. Starch grains from raw potatoes are recognised by their ovoid, highly refractive, three or four cornered, smooth granules with deep furrows running lengthwise. If boiled potatoes have been used granules are absent and the cells usually round and elliptical.—P.J. ii./15,549.

Reverting again to the consideration of the best type of flour and bread made from it, Dr. Hamill in the No. 14 Food Report to the L.G.B. says in his *General Review*, the great practical difficulty in endeavouring to define any one variety of flour in terms of protein content, mineral content or other criteria is that such a definition to be effective would require preliminary standardisation of wheat which is impracticable in view of the fact that wheat supplies vary from different parts of the world. It is evident that, unless we live wholly on bread, which is not desirable, the differences between one bread and another do not matter much.

With regard to choice of bread for children, however (though here also a varied diet is insisted on) it is stated—"For those children who live largely on bread—there appears to be advantage in bread from flour of the '*entire*' wheat class or from wholemeal in which the bran is very finely ground. In these the presence of the so-called offal, including the germ, secures a somewhat larger quantity of mineral matter and of suitably combined Phosphorus or other substances as yet unknown, which has been proved to be of importance.

Tankard expresses his opinion definitely in favour of *white bread*. He is convinced that wholemeal bread, brown bread and bread made from 80% flour have no advantage. The crux of the matter seems to be that before the agitation a considerable quantity of inferior grades of wheat products could be readily obtained whereas subsequently little, if any, of these products were to be had. The mineral constituents make, it is thought, no difference whatever as "our daily average food intake contains far more of such material than wanted for bone-forming, etc." (*Not so by any means in the case of the children of the poor.*—W. H. M.)

He suggests as standards not more than, say, 40% moisture, and that the bread shall be prepared from pure wheat flour unbleached and free from added mineral matter of any kind.

With regard to bran—it does contain a high proportion of mineral matter and of proteins but is of course excluded from white flour and also according to Tankard from the 80% flour;—in any case, the Nitrogenous constituents of the bran portion of the grain are, according to Tankard, thought to be practically non-digestible. So far as the germ of wheat is concerned this is rich in proteins, but it is doubtful how far these are, in the crude state, physiologically available to man.—P.J. ii./11, 6, 71.

Jago (the '*Technology of Bread-making*'—1911, points out that 'Standard' Flour must include the germ of the wheat, but its enzymes give rise to objectionable changes from the very time of manufacture; excessive diastasic action is likely to occur with production of a sticky dough, and as a consequence heavy small loaves; acidity of the bread is also favoured as well as a tendency to the development of ropiness in the dough. As a set off to these objections there is the increased nutritive value of the bread.

CONCLUSIONS.—First of all the bleaching and 'improving' of flours cannot be too strongly condemned. In our opinion the removal of the whole of the bran layer which contains so large a proportion of salts (see table), and which may be deemed "bone-forming" constituents, is an erroneous proceeding. Physiologists have not been able to agree on the subject—views are diametrically opposed. Extreme advocates on one side say the whole grain flour contains all the nutriment and that the white bread has nothing left

in it, while the opponents of wholemeal bread appear to rely on the contention that 'offal' and the parts of the grain until now given to swine, etc., are not digestible by human beings—especially delicate children. Our own views would be as follows:—

Wholemeal flour is undoubtedly of value to children and to all who digest it with ease. In such it cannot be proved to have injurious effect, on the contrary there is strong evidence that it is the more nutritive.

The 'staying' power of wholemeal bread is relatively remarkable—hence economical.

Its more general use may be conducive to the more general exclusion of bleached and otherwise chemically treated flours of poor quality.

Bread Substitutes for diabetic patients employing **Biogene** (a soluble casein containing a small percentage of phosphates).—B.M.J. ii./16,871.

[P1] NUX VOMICA (Off.).

Now standardised to 1.25% Strychnine on the powdered drug (as U.S. VIII).

Nux Vomica Oil, Unsaponifiable constituents of.—P.J. i./13,7.

Strychnos Nux-blanda "Khabaung," a new species from Burmah has been mistaken for *S. Nux Vomica* which does not grow in Burmah. *S. Nux-blanda* contains neither Strychnine nor Brucine. The powdered seeds very closely resemble each other, but of the natural seeds *S. Nux-blanda* have a whiter colour and rougher hairy surface. Numerous other species of *Strychnos* in our colonies contain Strychnine.—A. W. Hill, "Kew Bulletin," Nos. 4 and 5, per C.D. ii./17,963; see also P.J. i./18,299.

Assay Methods.

Off. requires 1.25% Strychnine. U.S. now requires 2.5% Total Alkaloids (was 1.25% Strychnine).

U.S. IX. Assay.—Macerate 15 Gm. of Nux Vomica in 40 powder in a 250 Cc. flask with 150 Cc. of a mixture of Chloroform 1 volume and Ether 2 volumes for 10 minutes, then add 10 Cc. of Ammonia Solution and shake vigorously every 10 minutes for two hours; allow to stand for 10 hours. Add 25 Cc. of distilled water and again shake, and decant 100 Cc. of the (Ether and Chloroform) Solution representing 10 Gm. of Nux Vomica. Strain through a little cotton wool into a separator and rinse funnel and cotton wool with a little ether. Completely extract the alkaloids from the liquor with weak Sulphuric Acid, add Ammonia *q.s.* to render decidedly alkaline, and extract completely with chloroform. Evaporate the chloroformic solutions to dryness, dissolve the alkaloids in 10 Cc. N/10 H₂SO₄ and titrate the excess of acid with N/50 KOH using cochineal. Each Cc. of N/10 H₂SO₄ consumed corresponds to 0.0364 Gm. of the total alkaloids of Nux Vomica.

A menstruum of Amyl Alcohol 1, Chloroform 3, and Ether 4 is a useful solvent for the alkaloids in assaying.—P.J. ii./oo,574. A little Amyl Alcohol added to the Strychnine residue prevents decrepitation in drying.

Naylor favours a method based on Bird's or Alcock's process, concluding with Dowdard's Nitric Acid method of separating the two alkaloids.—P.J. ii./o5,125. The fat of Nux Vomica is about 4%. For composition, *vide* P.J. ii./o5,223.

By using Nitric Acid Sp. Gr. 1.435 containing 1% Nitrogen peroxide, the Brucine is destroyed in a mixture of the alkaloids in 15 minutes.

In the estimation of Strychnine in presence of Brucine, D. B. Dott finds the Nitric Acid (Gordin's process) should be allowed to react at ordinary temperature for 20 minutes, and higher temperature should be avoided.—B.P. Conf., 1914; P.J. ii./14,120.

Alkaloidal strength of powdered drug to be 2.5%—F.I. Standardisation for total alkaloid does not limit the content of strychnine.

Extractum Nucis Vomice Liquidum (*Off.*).

Off.—Standardised to 1·5% Strychnine.

U.S. IX. requires not less than 2·37 or more than 2·63 Gm. of the alkaloids of Nux Vomica. In the *Off.* assay method the brucine is entirely destroyed by the nitric acid in ten minutes by heating to 50° C.

Toxicology.—Simplified method of extraction of Strychnine by means of Acetic Acid and Alcohol. The Alcohol is useful to assist filtration.—P.J. ii./07, 639

Cold nitration of the Brucine with *active* nitric or acid rendered so by adding Sodium Nitrite essential, "50° Nitrations" cause a large percentage of error (loss). Gravimetric results supply erroneous deductions. Strychnine Nitrate is an anomalous salt to deal with by the process of immiscible solvents. Differences between standardised extracts of commerce were found of 10·5%.—H. R. Jensen. P.J. ii./16, 458.

Spectrum of Strychnine.—The smallest quantity, *e.g.*, 1/500 grain, can be detected—useful in cases of poisoning. Alkaloids generally give characteristic spectra.—J. J. Dobbie, Roy. Instn. Lecture, L. i./13, 1399.

Struxine.—A new alkaloid from Nux Vomica, probably a decomposition product either of Strychnine or Brucine.—H. H. Schaefer, Jl. Am. Ph. Ass., Dec. 1914, 1677, P.J. i./15, 241.

There is evidence of a further alkaloid in Nux Vomica apart from Strychnine and Brucine.—C. A. Hill, Pres. Add. B.P. Conf., 1920.

OLEA ESSENTIALIA.

"The History and Chemical Relations of the Terpenes."—One of a series of Post Graduate Lectures at the Pharm. Soc., by Sir W. A. Tilden, complete report, Perfumery Record, July 9, 1912.

Synthesis of the Terpenes.—Prof. Perkin, *ibid.*

Essential Oils,—their constitution and commerce.—J. C. Umney, *ibid.*

For **cold enfleurage** as used for Jasmin and Tuberose, a mixture of pork and beef fat is used.

Warm enfleurage can be used for the more stable Essential Oils, *e.g.* Rose, Cassia and Violet.

Petroleum Ether is also largely used, *e.g.*, for Violet. On removal of the solvent the so-called **Concretes** are obtained, *i.e.*, oils + resins, fats, colouring matter, etc.,—these by-products have to be removed to produce the "**Abso-lutes**."—J. C. Umney, P.R., July, 1912.

For the extraction of perfumes by distillation, solvent, etc., methods in addition to the above.—See P.R., Dec., 1913, 414.

Sources of Various Oils.—Island of Reunion yields Geranium Oil. Mexico.—Linaloe Oil. French Guiana.—Bois de Rose Femelle (for producing lily of the valley odours). Philippine Islands and Madagascar.—Ylang Ylang. Java, Burmah and Uganda.—Citronella Oils.

This latter oil is now used for making various artificial violet bodies.—J. C. Umney, P.R., Dec., 1913, 414.

Saponification process for Esters in Essential Oils and **Acetylation process** for alcoholic constituents, also methods for determining **Refractive Index** and **Optical Rotation**, are briefly dealt with in the B.P. appendices. A fuller account of both is provided in U.S. IX.

Terpeneless and Sesquiterpeneless ('T. and S. Free') Essential Oils.

Essential Oils, deprived of their Terpenes and Sesquiterpenes, which in many instances constitute a large proportion of the Oils have the advantage of being *stronger in flavour and perfume* than the natural Oils and are much more readily *soluble* than the latter.

Note.—The Terpene- and Sesquiterpene-free Oils are obviously more 'concentrated' than the Terpene-free Oils. For example, it is claimed that 70 and 80 of Terpene- and Sesquiterpene-free Lemon Oil = 100 of the Terpene-free Oil and that 50 to 60 of 'T. & S. free' Pumilio Pine Oil = 100 of the 'T free' Oil.

We have arranged a table of Solubilities showing the quantities of the 'T. & S. free' Oils which will dissolve in specified amounts of weak Spirit—45, 60 and 70% Spirits have been selected as probably generally useful.

TERPENE AND SESQUITERPENELESS OILS.

'T and S free' Oil.	Equivalent to 100 of Natural Oil.	Solubility in Alcohol.		
		100 Gm (112·38 Cc) of 70% (by vol.)	100 Gm (109·47 Cc) of 60% (by vol.)	100 Gm (106 Cc) of 45% (by vol.)
		Gm.	Gm.	Gm.
Caraway	50	50	20	2
Cinnamon (Ceylon) ..	75	35	3	0·175
Clove (Buds)	75	60	30	0·25
Coriander	75	50	15	0·35
Cumin	30	7·5	0·5	1*
Dill	40	70	15	0·5
Eucalyptus Globulus .	75	75	12	0·3
Fennel.. ..	35	2·7	0·8	0·6†
Geranium Afric. ..	75	70	10	0·18
Geranium French ..	75	70	2·5	0·1
Lavender	70	40	3·5	0·1
Lemon.. ..	3·5	50	5	0·25
Lemongrass	75	40	3·5	0·1
Limetta	8	70	20	0·15
Marjoram	35	5	1	1·5*
Myrtle.. ..	30	30	10	0·25
Neroli	40	30	2	0·12
Nutmeg	15	2·5	0·5	0·4*
Opoponax	20	4	0·4	0·35*
Orange, Bitter ..	1·7	25	1·5	0·9*
Orange, Sweet . .	1·75	40	1·7	0·1
Parsley	70	3·5	1·5	2*
Peppermint(American)	75	20	1	1*
„ Jap. ..	75	30	2·5	0·15
„ Mitcham ..	75	30	7	0·2
Pimento	75	50	2	0·1
Pinus Pumilio ..	6·6	0·3	0·1	0·25†
Pinus Siberica ..	35	25	2·5	0·1
Pinus Sylvestris ..	15	40	1·5	1·5*
Rosemary	30	70	18	0·5
Rose, Bulgarian ..	75	0·25	0·12	0·15*
Sandal Wood ..	80	10	2·5	0·8*
Spearmint	70	35	1	0·6*
Star Anise	75	2·7	0·8	0·6†
Thyme.. ..	25	25	8	0·1*

Note.—*These figures refer to weights of a 1 in 10 solution in Alcohol 80% by volume.

† These refer to weights of a 1 in 10 solution in Alcohol 90% by volume. *All other figures refer to the actual Terpene- and Sesquiterpene-free Oils.*

It is doubtful whether an oil containing very delicate esters, *e.g.*, **Bergamct oil**, is improved by removing the terpenes. Further, there is no point whatever in rendering terpeneless an oil consisting almost entirely of its odorous constituent such as **Clove Oil**.

Lemon Oils from which the terpenes only have been removed contain in the neighbourhood of 42 to 45% Citral, whilst those from which the sesquiterpenes have also been taken contain up to 65%, or, as claimed by some makers, 72% Citral. The removal of the sesquiterpenes, in addition to the terpenes, causes the Oil to lose the sweetness and softness of a well-made terpeneless oil. Some users hold that the best results are obtained with an Oil containing under 40% Citral from which the whole of the terpenes have not been removed.—E. J. Parry, C.D. ii./13,378.

Lemon Grass Citral, now purified to such an extent that the Verbena odour is completely removed, is possibly used to adulterate Sesquiterpeneless Lemon Oil. It will be seen from the following—

Sesquiterpeneless Lemon Oil,	Sp. Gr.	0.895,	Rotation	0° or to 1°, Citral	65%.
Terpeneless Lemon Oil,	Sp. Gr.	0.895,	„	-3 to -4°, „	45%.
Citral,	Sp. Gr.	0.895,	„	0°, „	100%.

that it is possible to add to 100 parts of Terpeneless Lemon Oil 80 or 90 parts of Citral to produce a Sesquiterpeneless Lemon Oil differing only by its rotation of -2.—See also p. 119.

Indian Essential Oils.—Lemon Grass Oil is one of the chief oils distilled on the West Coast, but there is room for improvement in manufacture. The night-flowering plants of India may yield possibilities.—C.D., 1920, p. 1435.

Synthetic Perfumes.—For a synopsis of the principal bodies used in making synthetic perfumes *vide* Pharm. Formulas, 1914, and Perfumery Record, July 5, 1914.

Carminative Volatile Oils applied to mucous membrane in dilute solution increase muscular movements in the intestine in dogs. Effects lessened by Atropine.—O. H. Plant, Jl. Pharm. & Exp. Therap., Nov. 1920.

ANTISEPTIC POWERS OF ESSENTIAL OILS.

We took occasion in 1910 to determine the “*Lancet*” Carbolie Acid Coefficient (using *B. Coli Communis*) of the more important Essential Oils and aromatic substances.

The experiments were conducted with selected Oils of known composition.

The paper in question, *vide* “Perfumery and Essential Oil Record,” Nov., 1910, was divided into two portions—the first giving the minimum lethal strengths, using Aqueous Solutions with 2 and 30 minutes contact, and the second the minimum lethal strengths with Saponaceous Solutions (diluted at time of use to form emulsions). From these the **Carbolic coefficients** were obtained by stating the comparative strength with Phenol Solution. In other words by dividing the M.L.S. (Minimum Lethal Strength) as compared with unity of the Essential Oil Dilutions by the M.L.S. as compared with unity of the Phenol Dilution, we obtained Coefficient figures at respectively 2 and 30 minutes—(100 and 170 respectively were the M.L.S. for Phenol)—the mean of the two results is the Carbolic Acid Coefficient.

The antiseptic power of many of the Oils cannot be determined by Aqueous solution owing to the fact that a saturated aqueous solution is not strong enough to kill the test organism—here the Saponaceous Solutions overcome the difficulty.

The Coefficients so obtained show that several of the Oils possess considerable antiseptic power. It is of interest to note that the two

isomeric monatomic phenols, Carvacrol and Thymol, homologues of Phenol (acknowledged valuable antiseptics)—disputing the premier position in the table, have almost the highest molecular weights of those occurring in the commoner Essential Oils.

It must be clearly understood that the Coefficients are merely approximate. Further it is obvious that these Oils might produce entirely different Coefficients if another organism were employed. The Eucalyptus Oils and Eucalyptol for example, might appear higher in the scale if the organisms associated with nasal catarrh, *e.g.*, *B. Septus*, *B. Influenzae*, *B. Friedlander*, *Pneumococcus*, *M. paratetrigenus* or *M. Catarrhalis*, etc.—were used as test organisms.

The details of methods employed are given in the original paper. Several criticisms of the paper which appeared are now replied to.

As an outcome of this investigation Saponaceous Solutions of some of the Essential Oils are prepared for physicians' use under the name **Perfumed Formosyls**, *vide Vol. I.*

The results were briefly as follows :—

Essential Oil Dilution.	C.A.Co-efft	Chief Chemical Constituents.
<i>Origanum Oil (A.)</i>	26	82% Phenols, <i>e.g.</i> , Carvacrol.
<i>Thymol (S.)</i>	25	—
<i>Carvacrol (S.)</i>	21	—
<i>Thymol (A.)</i>	19	—
<i>Thyme Oil (S.)</i>	15	46% Phenols (Thymol, &c.)
<i>Thyme Oil (A.)</i>	13	<i>As above.</i>
<i>Geraniol (S)</i>	12	—
<i>Cinnamon Leaf Oil (S.)</i> ..	10	86% Phenols, <i>e.g.</i> , Eugenol.
<i>Cinnamon Bark Oil (S.)</i> ..	9	52 % Aldehyde, <i>e.g.</i> , Cinnamic
<i>Clove Oil (S.)</i>	9	90% Phenols, <i>e.g.</i> , Eugenol <i>v. ante.</i>
<i>Cinnamic Aldehyde (S.)</i> ..	8	—
<i>Citronellol (S.)</i>	8	—
<i>Cinnamon Bark Oil (S.)</i> ..	8	82% Aldehyde (Cinnamic Aldehyde)
<i>Cinnamon Bark Oil (A.)</i> ..	7	82% Aldehyde.
<i>Rosemary Oil (S.)</i>	6	—
<i>Otto of Rose (S.)</i>	6	68% alcohols estimated as Geranio .
<i>Cassia Oil (S.)</i>	5	83.5% Aldehyde (Cinnamic).
<i>Wintergreen Oil (S.)</i>	5	Methyl Salicylate.
<i>Eucalyptus Amygd. (S.)</i> ..	5	Chiefly Phellandrene (a Terpene) and Eucalyptol.
<i>Lavender Oil (English) (S.)</i>	5	Esters as Linalyl Acetate $\text{CH}_3\text{COOC}_{10}\text{H}_{17}$, 11%. Linalool is isomeric with Geraniol. Other constituents of the oil are Linalool as such, Esters, other than the Acetate, Cineol and Limonene.
<i>Lemon Oil (S)</i>	4	Limonene, Citral 4 to 7% Citronellal, Geranyl Acetate, possibly other esters of Geraniol and Citronellal.

A = Aqueous Solution
S = Saponaceous Solution.

Essential Oil Dilution.	C.A.Co-efft	Chief Chemical Constituents.
<i>Almond Oil, Essential, S.A.P. (S.)</i>	4	Benzaldehyde chiefly.
<i>Eucalyptol (S.)*</i>	4	—
<i>Eucalypt. Glob. Oil (S.)</i> ..	4	67% Eucalyptol together with Pinene, Phellandrene, Alcohols and Aldehydes.
<i>Garlic Oil</i>	2	Allyl Sulphide chiefly, see p. 352.
<i>Light Oil of Tar (Rectified) (S.)</i>	2	Volatile Bodies. Contains no Phenols.
<i>Santal Oil (S.)</i>	1½	Contains 93·8% Alcohol calculated as Santalol $C_{15}H_{23}OH$.
<i>Birch Tar Oil (S.)</i>	1½	Stated to contain Guaiacol, Cresol and Pyrocatechin.
<i>Cade Oil (S.)</i>	1	—

A = Aqueous Solution.

S = Saponaceous Solution.

**Eucalyptol*.—G. I. Hudson writes us (15/1/17) that he has found the C. A. coefficient on similar lines to be 4·4.

L. Cavel (see P.R., September, 1918) working independently and on somewhat similar lines came to the same conclusions broadly speaking. He also places **Thyme** and **Origanum** Oils at the head of the Antiseptic Oils and the order in his list is very much in agreement with our own.

REPLIES TO CRITICISMS.

B.M.J. ii./10, 1935, inquired for details of manufacture of the Saponaceous Solutions used and pointed out that Emulsions of different Oils may vary. The figures are also criticised and the fact that Eucalyptus and Sandal Wood Oil appear so low is remarked upon.—In reply we would say that the Saponaceous Solutions were pharmacutically prepared and from these, Emulsions were produced with water.

In respect to **Eucalyptus** and **Sandal Wood Oils**, these surely have a claim to be classed as powerful germicides seeing we find they are 4 and 1½ times, respectively, as powerful as Carbolic Acid, which itself ranks as a strong disinfectant. The surprise is that they should approach the power of Phenol at all, especially Sandal Wood Oil, which is a bland innocuous substance compared with Phenol.

We agree as to the general belief that the physical conditions of such emulsions may be of importance. In support of this it is frequently pointed out in the paper that the soap present appears to assist in germicidal power, possibly by mechanical action.

We cannot agree that comparative results with Oils differ to such an extent that Emulsions of Essential Oils (made as nearly as circumstances will permit under identical conditions) may be no criterion as to relative antiseptic powers. The results give the relative strengths of certain Oils under stated conditions. Since this criticism appeared we determined approximately with the aid of a Thoma Zeiss apparatus the size of the globules of the Oils in the Emulsion all of dilution strength 1 in 120 and found as follows:—

Gaultheria Oil	.. ..	½ to 5 microns;
Cinnamon Bark Oil (82% Aldehyde)	.. ..	1 „ 10 „
Cassia Oil	.. ..	1 „ 10 „
Sandal Wood Oil	.. ..	1½ „ 5 „
Lemon Oil	.. ..	1½ „ 2 „
Eucalyptus Amygdalina Oil	.. ..	1½ „ 2 „
Origanum Oil	.. ..	1½ „ 5 „
Rosemary Oil	.. ..	1½ „ 5 „
Tar Oil	.. ..	1½ „ 2 „
Lavender Oil	.. ..	Nil.
Eucalyptol	.. ..	Nil.
Eucalyptus Globulus Oil	.. ..	Nil.

The minimum lethal strengths of the various Oils were in most instances less than this 1 in 120; this strength was found convenient to work with in the Thoma Zeiss cell. The size of the globules operating on the bacilli in the experiments may therefore be taken as certainly not larger than the dimensions stated above. It may be of interest to note that the diameter of the fat globules in cows' milk is on an average $1\frac{1}{2}$ to 10 microns, hence our Emulsions may be regarded as satisfactory. The length of the Colon Bacillus is about 2 to 4 microns.

Clearly the smaller the dimensions of the globules the greater number of them present and the larger the surface area of the chemical substances to act upon the bacteria. We deal with the chemical action later.

With regard to figures our B.M.J. critic draws attention to the fact that we obtained a Coefficient for Origanum Oil containing 82% Carvacrol of 25.8 whilst Carvacrol as such only showed a coefficient of 21.3. It is obvious that the constituents making up the balance of 18% of the Oil may have chemically or physically greater potency than Carvacrol itself, or they may enhance the activity of Carvacrol. The difference between the Minimum Lethal Strengths as at 2 and 30 minutes, which gave the Coefficients 21.3 and 25.8 is practically negligible when one recalls the fact that we are dealing with a minute bacillus and an antiseptic under empirical conditions. For further data in answer see "Perfumery Record," Jan., 1911.

With regard to the "Lancet" criticism (Lancet, Dec. 11, 1910, p. 1779) we would refer to the remarks above as to the size of the globules. The "Lancet" says:—

"The relative values of the Oils in regard to Carbolic coefficient may not necessarily be dependent upon the essential constituent, for undoubtedly a greater inhibitory action on organisms is shown by a perfectly uniform emulsion, in which the separated particles are exceedingly fine, than by an emulsion which exhibits irregularities or suspended particles varying in dimensions." The matter might, therefore, develop into the question, What is a uniform Emulsion, and what diameter shall the oil globules have? If cows' milk be regarded as a uniform emulsion then the Emulsions produced by our Saponaceous Solutions according to our measurements may come within this category.

The "*Lancet*" remarks that Surgeons and Physicians "are not necessarily dependent upon disagreeably smelling Phenol compounds as the basis of strong germicidal preparations."

With regard to the "*Chemist and Druggist's*" remarks, the fact that the efficacy of Eucalyptus Oils in colds and catarrhs is "not owing to bactericidal properties as measured on *B. Coli Communis*" is evident from the figures. It is quite likely that any kind of Eucalyptus Oil kills the influenza and catarrhal bacilli better than most other essential oils. Experiments which we instituted with certain catarrhal organisms had to be reluctantly dropped for the reason that we found the organisms difficult to cultivate in the conditions required—it was impossible to draw conclusions from the results.

A well-defined, easily-cultivated bacterium is absolutely essential for such experiments.

'*The Lancet*' (L. ii./12, 1387) in a review of the action of Phenols and other bodies on bacterial protein which gives them marked bactericidal action, enquires as to how the Essential Oils act. What affinity, if any, occurs between the oils and bacterial protein?

It is shown that certain substances, e.g., Formaldehyde, have a direct interacting power with Protein. In the case of the Phenols and Cresols the action is more complex and a theory has been set up on the lines of an upheaval of the colloidal elements of the bacterial body and consequent formation of an irreversible substance. The precipitated protein is not again dispersed. The action is in short very similar to that of heat—as in the case of heating egg albumen.

Bringing this to bear upon the Essential Oils we see that the Oil heading the list contains 82% of Carvacrol or allied Phenol and that the substance is practically as strong as is the phenolic Thymol which is isomeric with it. Then follows Thyme Oil with 46% Thymol

and subsequently Cinnamon Leaf and Clove Oil containing 86% to 90% Eugenol (or allied bodies). A little lower comes Cinnamon Bark Oil (82% Aldehyde).

In short we have in these preparations, *especially in the minute subdivision effected in Saponaceous Emulsions just the very bodies—higher up in the homologues series* which were known to be markedly antiseptic. The two isomeric PHENOLS which rank highest in our experiments have almost the highest molecular weights of those occurring in the commoner Essential Oils—far higher than Phenol or the Cresols, herein is doubtless an answer to the question of how the Essential Oils act. To introduce the colloidal theories would not appear to greatly assist the matter. We should ascribe the effect to one analogous with that of the caustic action of Phenol on the tissues—a direct attack on protein. Bacterial protein one assumes to be particularly responsive to these antiseptic oils.

‘Edmunds’ Cell’ Experiments.—Numerous Essential Oils were tested by this method, and the results communicated by Sir Watson Cheyne in the Hunterian Oration, 1915.

It is remarkable that several of the Oils, for example, Origanum and Cinnamon and Clove Oil, have the power of *diffusing* or penetrating an (aqueous) Agar culture medium in this manner. *c.f.* Vol. I., p. 33, also P.R. March, 1915, and C.D. March 27, 15.

Essential Oils, Preservative action—estimated roughly by their power of preventing growth of mould in a 50% Glucose and a 50% Sugar Solution containing Meat Extract. Of those that did *not* act as preservatives may be cited,—Calamus, Celery, Cubeb, Lemon, Orange Peel, Sandal. The list of those with preservative action resembles our own earlier findings, *c.f. antea*. To these may be added Cajuput, Cardamom, Chenopodium and Cumin.—J. Amer. Pharm. Ass., 1912, 1, 1273; P.J. ii./12, 649; Y.B.P., 1913, 79.

Essential Oils, Unification of Process of Analysis.—Umney and Parry, also Jeancard.—P.R., 1912, 245.

The Odorous Principles of Plants.—F. B. Power, C.D.’19, 971, 1003. See also J.C.S.A. i./19, 607.

OLEUM LAVANDULÆ FLORUM.

Volatile oil from *Lavandula vera* (*Labiata*), has Sp. Gr. usually not below 0.885 up to 0.900 at 15.5° C. Soluble in three parts of 70% Alcohol. Shaken with water in a narrow graduated cylinder, volume of oil should not be diminished (absence of alcohol) (U.S.). Terpinolene (*q.v.*) is an adulterant. English oil should contain from 7 to 11% of esters, and the foreign oil not less than 30% of esters, calculated as linalyl acetate $C_{10}H_{17}C_2H_3O_2 = 196.22$, as determined by saponification with alcoholic potash—*Off.*

This 30% minimum for the foreign excludes some genuine high-grade samples.—Parry. There is no evidence to show that the esters improve the odour or that they have any medicinal value.—Henderson, P.J. ii./10, 138.

Ph. Ital. requires about 35% Linalyl Acetate.

OLEUM LIMONIS.

Syn. Oleum Citri. P.G.V.

From fresh Lemon Peel by expression. Sp. Gr. 0.857 to 0.860. O.R. not less than +59°. U.S. requires 4% Aldehyde by weight calculated as Citral. It ranges from 4 to 7%. Citral $C_{10}H_{16}O = 152.178$ is optically inactive. Sp. Gr. 0.893 to 0.897. It occurs in a number of other essential oils. A somewhat extensive investigation by U.S.A. authorities went to show that where pinene is found in Lemon Oil, using ordinary means of distillation, it is *prima facie* evidence of adulteration.—Examination of Nitro-

sochloride crystals from the Oils.—C.D. ii./09,824. Other authorities are, however, of opinion that Pinene is a natural constituent of Lemon Oil. Umney says Pinene may or may not be present. The Nitrosochlorides of other terpenes may be similar to that of pinene.

Bennett's Hydroxylamine process, *vide* P.J. i./09,463. It appears to give results about 10% too low.—P.J. ii./10,437.

P.G.V. requires that the oil shall be *soluble* clearly 1 in 12 of Alcohol—or to show only a little flocculent matter,—*absence of Fatty Oil and Paraffin*.

Lemon Oil, Terpeneless and Sesquiterpeneless.—1 part equals in flavour 20 to 30 of ordinary Oil. It is soluble in comparatively weak Alcohol see also **Olea Essentialia**, p. 112.

TERPENELESS LEMON OIL MANUFACTURE.

The distillation in Southern Italy is a very "rule of thumb" matter and is as follows:

Lemon Oil of undoubted purity and good quality (*i.e.*, Citral (by NH_2OH method) 4.7 to 5% ; O.R. 60 to 64° at 15.5 ; Sp. Gr. 0.857) is distilled in a copper still under reduced pressure—about 20 mm., at which it boils at 56 to 63°—a water bath is used. From this about 93% is distilled off consisting chiefly of Limonene containing 1.5 to 2.0% Citral (NH_2OH method). The residue in the still is now steam distilled and thus about 4½% "Terpeneless Oil" is obtained and about 2½ to 3% gummy residue left in the still. The Terpeneless Oil so obtained has O.R. of from—3 to—10° and a Citral content of from 40 to 50% ; Sp. Gr. 0.895 to 0.9. There are a few trade secrets connected with the matter. Oil which contains any impurity whatever is quite useless for the process. Turpentine (a favourite old adulterant) ruins the finished oil ; Terpenes diminish the quantity of product sought ; Lemon Grass Citral increases its quantity but previously this gave an unfortunate "verbena" odour which would at once be detected by an expert. Now the purification Lemon Grass Citral is such that the verbena odour cannot be traced. The Oil must be pressed from fruit which has been gathered by hand at the end of the "green" stage and just when it has become completely yellow ; the fruits must not be damaged.—W. C. Slater, see also p. 114. For further details consult the works of Parry, Allen, etc.

Lemon oil varies from season to season. Citral content for 1915 was high. 4.7 to 5.3%. Optical rotation, however, in many instances below that of the B.P.—P. R.

For Lemon Tincture and Syrup, see *Vol. I.*, p. 806

'**Oleum Citron**,' so called, in this country is usually a blend of Lemon, Orange, etc. (Distinguish from *Oleum Citri*—"Citronenöl" P.G.V. which is our *Oleum Limonis*—*vide antea*). **Bergamot Oil** is from *Citrus bergamia* peel, by expression from the ordinary Bergamot. Sp. Gr. 0.882 to 0.888.

Citral, Colorimetric Determination.—C. E. Parker and H. S. Hiltner, Y.B.P. 1919,67.

OLEUM MENTHÆ PIPERITÆ.

Analysis shows English Oils have a certain proportion of ester with a decidedly high pungency value as shown by the total menthol percentage, while French Oils are in the other extreme, *i.e.*, a low total menthol with a somewhat high ester percentage. A blend of the two might be of use where pungency and softness is required.—P.J. ii./10,723,731.

Peppermint grown in a damp situation is said to yield only ¼ the amount of oil of that grown under ordinary conditions, but this is not the case in experiments at Hitchin. Cultivation in the shade does not appear to increase yield of oil.—*Vide* P.J. ii./11,175.

Evans' Analytical Notes, 1914 to 1919, gives the following findings:—

English—Sp. Gr. 0.896—0.9084, O.R. —25 to —30, R.I. 1.4593 to 1.4605, Ester value 6.36 to 11.9, Menthol 50—68.4%.

American—Sp. Gr. 0.901 to 0.911, O.R. —23 to —29.5, R.I. 1.4591 to 1.4648, Ester value 7.4 to 14.7, Menthol 51—69%.

Wayne County—Sp. Gr. 0.899 to 0.909, O.R. —22 to —29, R.I. 1.4595 to 1.4628, Ester value, 4.95 to 12.9, Menthol 50 to 62.8%.

Dutch—Sp. Gr. 0.9, O.R. —21, R.I. 1.4586, Menthol 59.8%.

Japanese (Dementholised)—Sp. Gr. 0.894 to 0.9004, O.R. —25 to —30, R.I. 1.4585 to 1.4628. Ester value 7.4 to 9.2.

(*Off.* requires not less than 50% Menthol and 5% Esters calculated as Menthyl Acetate.)

Menthol and Peppermint Oil in Alcohol Solution. — Test to distinguish.

If Tincture of Iodine be added to a Solution of Peppermint Oil, several drops, more or less, may be added before the yellow tint of Iodine is perceptible. With a solution of Menthol there is no absorption, so the yellow tint is seen at once.—Y.B.P., 1913, 88.

Piedmontese Oil—The district said to be the Mitcham of Italy. Mitcham plants introduced paid for cultivation.—C.D., 1920, 1507.

OLEUM MORRHUÆ. (*Off.*).

Sp. Gr. 0.924—0.931 includes all genuine samples. **Unsaponifiable Matter.** In good quality oil rarely exceeds 1.6%; use full excess of alkali before extraction; wash Ethereal Extract at least 4 times (*Parry*). **Free Fatty Acid** calculated as Oleic should not exceed 1%, easily estimated. Many samples fall below 0.5%. **Iodine Number** 155 to 170 (*Hübl's Solution ditto*). We found Acid Value not exceeding 2.5. No separation of solid fat should take place on exposure of the oil to a temperature of 0° C. for three hours. (*Off.*). 1 Cc. of the oil dissolved in 10 Cc. of Carbon Disulphide may give a violet blue colouration when gently shaken with one drop of Sulphuric Acid.

An authentic sample of Norwegian Oil gave **Sp. Gr.** 0.9270, **S.V.** 185.8, **I.V.** 165.2. Unsaponifiable matter 0.69%, η_D 1.4800, free fatty acid (as Oleic) 0.32%.—*Southall's Rep.*, 1913, p. 10, per Y.B.P., 1913, 100.

Over 50% of the medicinal oils give **Refractive Index** 1.4801 to 1.4802. The **Iodine value** in **Best Medicinal Oils** was 151.1 to 178.7.—*Evans*.

Bases to the extent of 0.05% have been found, including Butylamine, Isoamylamine, Hexylamine, Dihydrolutidine, which are volatile and the non-volatile Morrhaine $C_{19}H_{27}N_3$ and Aselline $C_{25}H_{32}N_4$. *Fahrion* assumed the presence of Asellic Acid $C_{17}H_{32}O_2$ in the liquid fatty acids from Cod Liver Oil, which had **I.V.** 175.5. Cholesterol is a characteristic constituent ranging from 0.46 to 1.3%.—*Benedict and Lewkowitsch*, p. 392.

Phosphorus, it is said, is not found in neutral oils, but only in acid samples and Iodine only when decomposition of the liver has occurred. The activity of the oil is not due to these bodies. Presence of the last mentioned may be sought by fusing with Sodium Carbonate.

I.V.'s (by *Wij's method*) 118.4—178.7 were found for the oil and 165.6—178.7 for the Acids obtained therefrom, indicating molecular values 319.7—524.4. Hydroxylation and polymerisation between the double bonds and Carboxyl groups may possibly account for a decrease in **I.V.** In an attempt to prepare the Acids as they exist in the oil, *e.g.*, by treating with Alcoholic Potash in presence of Hydrogen, an acid with 18 carbons and 4 double bonds, having a molecular weight of 290.5 was obtained.—*Owen T. Williams, P.J. ii./12, 806.*

E. F. Harrison regarded Iodine Monobromide as the most trustworthy reagent. He obtained **I.V.** 165—170 for the Oil. *O. T. Williams* stated he had subsequently obtained similar figures on other samples of oil.

For further details of the general chemical composition, see *Vol. I., especially a paper by O. T. Williams, pp. 593, 594. c.f. also Oleum Papaveris, Vol. I.*

OLEUM OLIVÆ (*Off.*).

Sp. Gr. 0.915 to 0.918. **U.S. Saponification No.** is 190 to 195 and **Iodine No.** not less than 79 or more than 90. *Off.* differs slightly in **Iodine No.**

Halphen's Test for Cotton Seed Oil.—2 Cc. of the Oil mixed with 1 Cc. of Amyl Alcohol and 1 Cc. of a 1% Solution of Sulphur in Carbon Disulphide and placed in a test tube immersed in boiling water or boiling brine should not develop a red colour in 15 minutes—absence of

For Arachis Oil.—Boil 1 Cc. of the Oil and 15 Cc. of Alcoholic N/1 KOH for 20 minutes under reflux condenser and keep 24 hours at not exceeding 15° C. A cloudiness or distinct deposit of crystals (Potassium Arachidate) would indicate presence of Arachis Oil. The test can be modified to give quantitative results—*Bohrisch—Pharm Zeit., 1910, 471.*

For Sesame Oil.—2 Cc. of the Oil shaken for $\frac{1}{2}$ minute with 1 Cc. of strong Hydrochloric Acid containing 1% of Cane Sugar and allowed to stand for 5 minutes, the acid layer should not become pink (U.S. slightly modified). Our experiments showed that 5% or even less of Sesame Oil working with a pure control is quite easily detected by this test. We found that 20% of Sesame Oil gives a deep red. The reagent must be freshly prepared.

It is also necessary that the Sesame Oil shall be recent. We have found that old Sesame Oil fails to give the red colour—on the contrary, it produces a characteristic light green colour.

Olive Oils ought not to be condemned as impure on the basis of the test. Experiments with Spanish, Italian, etc. brands.—C. E. Sage, P.J. i./15, 128.

Modified B.P. Test. Dissolve Cane Sugar 0.1 Gm. in 5 Cc. Hydrochloric Acid and allow to stand 15 to 20 minutes at 20 to 25°C. The colour will then be faint cream. Shake 5 Cc. of the solution with 10 Cc. of the oil and 5 Cc. of Petroleum Spirit for 10 minutes. By this means $2\frac{1}{2}\%$ of Sesame Oil can be detected. The B.P. method may miss more than $2\frac{1}{2}\%$.—Evans Anal. Notes.

Nitric Acid Test for other Oils.—Agitate 5 Cc. of the oil with 5 Cc. of HNO_3 Sp. Gr. 1.30 and heat for 5 minutes. There should be no darkening and the oil should have set firm in 12 to 18 hours.

For Tea Seed Oil. (J. Cofman-Nicoresti).

Tea Seed Oil and Olive Oil are practically identical in chemical and physical characters.—C.D., '20, 277; P.J. ii./20, 139.

Prepare a mixture of concentrated nitric acid, concentrated sulphuric acid and water, equal parts by weight. Of this mixture 10 Cc. is well shaken in a test-tube with 10 Cc. of the oil to be analysed, and placed in boiling water for twenty minutes. Should any tea-seed oil be present the oil layer changes to a cherry-red colour. The colour varies with the amount and quality of tea-seed oil present, the crude oil gives a deeper colour. When cool, samples of pure olive oil solidify to a yellow, nearly white, mass, while the adulterated oil remains liquid or semi-solid, according to the amount of tea-seed oil present, having the characteristic colour. When the tea-seed oil is less than 20 per cent. it is better to work on 50 Cc. of oil and 30 Cc. of the acid mixture.

Our experiments with the test gave the following :—

1. **Employing Tea Seed Oil** 10 Cc. and 10 Cc. of the mixed acids, the oily layer quickly turned dark brown, nearly black. On continued heating as directed the colour fades partly, leaving an orange red coloured layer, containing black particles in suspension. On cooling, the oily layer becomes very thick, but gives no signs of solidifying.

2. A mixture of equal parts of good **Olive Oil and Tea Seed Oil** on heating with the acid mixture became light brown, and on continued heating faded to a dark yellow tint. On cooling the oily layer became a semi-solid mass.

3. Employing **Olive Oil** alone the change in colour was very slight, and at the end of twenty minutes' heating had only assumed a lemon yellow colour. On cooling the oil settled to a solid mass.

4. **Nut Oil.** In this case the colour change is more marked than with Olive Oil. After 20 minutes' heating the oil had assumed an orange colour. This on cooling solidified in an exactly similar manner to Olive Oil, the only difference being the slight darkening in colour.

OLEUM ROSÆ.

Characters and Tests.—The Sp. Gr. of Otto ranges from about 0.850 to 0.860 at 30° C. (compared with water at 15° C.), R.I. at 25° about 1.460 to 1.465; M.Pt. about 20° to 22.5° C. Mixed with an equal volume of chloroform it does not congeal and is convenient for use. Saponification value (U.S. VIII) not less than 10 nor more than 17. It contains 70 to 75% of

Geraniol $\text{CH}_3 > \text{CH} - \text{CH}_2 - \text{CH} = \text{CH} - \text{C}(\text{CH}_3) = \text{CH} - \text{CH}_2 - \text{OH}$ or $\text{C}_{10}\text{H}_{18}\text{O}$ = 154.194 (the $\frac{1}{4}$ quarters of the liquid portion), and Citronellol $\text{C}_{10}\text{H}_{20}\text{O}$ = 156.21 (the remaining 25%). Linalool is isomeric with Geraniol, Sp. Gr. 0.870. B.Pt. 197°. It is contained in Coriander, Thyme and other oils and is either + or - rotatory.

Off. Constants for Sp. Gr., etc., of Otto differ from the above in some particulars.

'**Rhodinol**' is a blend of the two Alcohols from Pelargonium Leaf Oil. It is a mixture of Geraniol and Citronellol and not a pure substance. Some workers give the name as synonymous with Geraniol—others as synonymous with Citronellol.

75 or 76% at most is the highest amount of alcohol calculated as Geraniol that should be allowed in a normal pure Otto. Pure Otto never has specific gravity as high as 0.862. Frequently it is as low as 0.850. Any Otto with a refractive index below 1.4600 is adulterated, and almost invariably with alcohol. Considering that about 50% of the adulterated samples contain alcohol, which is used to adjust the high Sp. Gr. and R.I. of the Geraniol Compounds added, the following test (invariably applied by analysts) is valuable.

"If 5 Cc. be well shaken with 10 Cc. of warm water and the mixture allowed to separate, the refractive index of the washed oil at 25° C. should not differ from that of the original oil by more than 0.0015 (absence of alcohol)."

The determination of the R.I. should be made on the separated otto when quite clear, filtered if necessary, but not dried with any drying agent, since the original oil, owing to the method of distillation is saturated with water.—Parry, C.D. ii./11,450.

Otto of Rose analysis and details of Adulterants,—Alcohol, Oleum Cedri Ligni, Palmarose, Gurjun Oil, etc.—P.R., Dec., 1913,416.

Though the predominating constituent, Geraniol is by no means the most important as both Citronellol and Nerol, and esters of the respective Alcohols and other bodies contribute largely to its fragrance. Phenyl Ethyl Alcohol, which possesses a mild odor, appears to be contained in Otto and in Neroli Oil, not only as such but also in form of esters of Benzoic and Phenyl Acetic Acids. Although this Alcohol is contained in exceedingly small quantity in Otto, it represents quantitatively the chief volatile constituent of rose petals. Being freely soluble in water, it remains behind for the most part in the aqueous portion of the distillate from which the Otto has been removed.

The so-called **Stearoptene** of Otto is a Paraffin with formula $C_{16}H_{34}$, but Schimmel showed that it is not a simple substance but a mixture of homologous hydrocarbons.—F. B. Power, P.J. ii./13,490; C.D. ii./13,515.

Geraniol and Citronellol estimation, Bouley's Method.—Bull. Soc. Chim. 1912,11,915; Y.B.P. 1913,73; Bennett P.R. 1913,3,334.

The presence of Otto in the air is readily recognised when only 0.000,000,000,000,000,333 Gm. of it is present in a cubic mm. of air.—L. i/13,184.

OLEUM ROSMARINI.

A colourless or pale yellow oil soluble 1 in 1 of 90% Alcohol and 1 in 5 to 10 of 80% Alcohol. Distilled from flowering tops of *Rosmarinus Officinalis* (*Labiatae*). Sp. Gr. from about 0.895 to 0.920. U.S. requires not less than 2.5% Ester calculated as Bornyl Acetate and not less than 10% of total Borneol.—*Off.* requires practically all these constants:

Internally it is a carminative, and externally promotes the growth of the hair.

OLEUM SANTALI.

Sandal Wood Oil should be soluble 1 in 6 of 70% alcohol at 20° C. It should contain not less than 90% alcohols, calculated as santalol, $C_{16}H_{24}O$.—Sp. Gr. 0.973 to 0.985.

O.R. (*Off.*) —13° to —21°. Refractive Index 1.498 to 1.508 at 25° C. U.S. Specification is similar. The Oil is now distilled in Government factories in Mysore.—P.J. ii./16, 49.

West Australian Sandal Wood Oil does not contain Santalol but a nearly related compound. The oil is, however, equal in effect to the true article.—C.D. '20,747. See also P.R. 1920, p. 83.

Copaiba.

Off. has Sp. Gr. 0.975 to 0.995.

For Maranham and Maracaibo varieties the Acid Number is at least 75. Para and Bahia varieties contain a greater proportion of volatile oil, consequently lower acid number.—Umney, C.D. ii/69,579.

P.G.V. gives Acid No. 75.8 to 84.2, Saponification No. 84.2 to 92.7. Special directions for procedure in both cases are supplied.

Test for Gurjun Balsam (U.S.).—Dissolve 3 or 4 drops of the volatile oil separated from Copaiba by distillation with steam in 3 Cc. of Glacial Acetic Acid. Mix the solution with 1 drop of freshly made 10% Sodium Nitrite solution and carefully underlay this with 2 Cc. of Sulphuric Acid. The acetic layer should not be coloured *pink*.

Loses 45% of its weight when heated at 100° C. for 48 hours—*Off.* When heated on the water bath a hard and brittle resin remains weighing not less than 36% of the original weight taken.—U.S. (Paraffin or fatty oils).

Samples latterly have been poor or purposely adulterated. The Gurjun Balsam test of the B.P. has to be treated with rather wide interpretation. The acid values, percentage of oil, optation of oil and other usual factors of Para and Maranham vary greatly.—Evans. (Umney 'contended that in a new Pharmacopœia either Para copaiba should be included or probably better, the Oil alone.')

For further details of Copaiba see *Oleum Santali, Vol. I*

OPIUM.

The ash of opium should not exceed 4% to 8%, moisture about 12%.

In the official assay process the Chlorine of the Ammonium Chloride combines with the Calcium and the Calcium Morphinate being decomposed, the Morphine is precipitated in the Saline solution in which it is sparingly soluble.—D. B. Dott, P.J. ii./18,318.

Of the 20 or more alkaloids in Opium, six are of more importance than the others. These occur in Turkey Opium as follows, approximately:—Morphine 9, Narcotine 5, Papaverine 0.8, Thebaine 0.4, Codeine 0.3, Narceine 0.2.—P.J. i./12,161. See also Allen, 4th Edn., Vol. VI., 417.

Estimation of Narcotine and Codeine in Opium.—Y.B.P., 1903,122.

Assay Process using Anhydrous Acetone for washing.—P.J. i./13,367.

Assay from International standpoint.—D. B. Dott, P.J. ii./20,199; Y.B.P. 1920, p. 18; see also P.J. ii./20,302; Y.B.P., 1920, 23.

Modified Dowzard Process for Assay of Opium Tincture.

Evaporate 100 Cc. to 25 Gm. on water bath. Mix intimately on cooling 3 Gm. Calcium Hydrate with a small pestle. Transfer to flask graduated at 102 Cc. Shake well seven or eight times in the half hour's digestion. Filter off and pipette 50 Cc. to an oval flask with 30 Cc. Ether, 5 Cc. Alcohol 90%, and 2 Gm. Ammonium Chloride. Shake 30 minutes, stand over night, remove Ether layer with a straight pipette through inter-leaved filter papers shake residue with 15 Cc. Ether. Again pipette off and wash papers with 5 Cc. Ether (0.720) twice thoroughly evaporate Ether from the papers and then filter aqueous residue (Morphine finally), washing pipette, etc. with 100 Cc. Morphinated water. Dry filter papers by identical compression. Digest each with 20 Cc. N/10 Sulphuric Acid, pulp the papers thoroughly, dilute with water and back-titrate with N/20 Sodium Hydrate using Methyl Orange.—H. R. Jensen, P.J. ii./13,876.

The presence of **Milk Sugar**, *i.e.*, as diluent of Opium may interfere markedly in the U.S. assay process.—C. H. La Wall, Jl. Am. Ph.A.; May, 1912,411; P.J. ii./12,75. Milk Sugar is no longer specified as a suitable diluent in U.S.

Starch also interferes.—P.J. ii./13,647.

In powdered Opium the amount of Morphine compounds insoluble in water appears to increase with age of the sample. Amount of total Morphine is also reduced.—P.J. ii./12,781.

Standardisation of all the Active Constituents of Opium suggested, *i.e.*, Morphine, Narcotine, Codeine and Meconic Acid, not on Morphine content alone.

The estimation of Meconic acid is colorimetric by means of (1) precipitation with Goulard's Extract; (2) subsequent comparison of the colour produced with Ferric Chloride—using a control of pure Meconic Acid. The paper should be consulted.

As a result of the examination of four samples of Opium the author found:—

Morphine	12.2%	14.1%	10.5%	12.4%
Narcotine.. . .	5.8%	4.8%	6.8%	7.6%
Codeine	1.1%	0.7%	1.5%	0.9%
Meconic Acid . .	5.4%	4.3%	4.5%	6.4%

—P. Van der Wielen, P.J. ii./13,114.

Estimation of Morphine in Omnopon and other Opiates.

Liberate the alkaloids by Sodium Bicarbonate and extract those other than Morphine by Chloroform saturated with Morphine; the Morphine is then extracted by a mixture of equal volumes of Isobutyl Alcohol and Chloroform, the extract is shaken with a known amount of standard Hydrochloric Acid, the excess of which is found by titration. The results are about 1.5% too high.—E. Anneler (Arch. Pharm., 1912,250, 186-198). J.C.S.A. ii./12, 819.

Estimation in Acid Liquids, *e.g.*, Sydenham's Laudanum of the Codex.—P.J. ii./13,881.

Ammonia is present in Opium to the extent of 0.2 to 0.3%. The odour of Ammonia is noticeable in estimating the Morphine content in Opium on liberating the alkaloids with lime in the B.P. process.—J. N. Rakshit, P.J. i./17,255.

Morphina.

For details of efforts at Synthesis of derivatives of Morphine (the structure of which is not known with certainty) *vide*—May.

Isolation of morphine in toxicology.—P.J. ii./05,617.

Solubility in Carbon Tetrachloride is 0.0156 Gm. in 100 Gm. at 18 to 22° C.—Y.B.P., 1913,6.

Spectrum lines characteristic for Morphine are obtainable with 1/200 grain.—J. J. Dobbie, L. i./13,1399.

For further details on Estimation *vide* Allen, 4th Edn., Vol. VI., 417-433.

Gregory's Salt. An impure Morphine Hydrochloride being a mixture or double salt of Morphine Hydrochloride and Codeine Hydrochloride occurring in the manufacture of Morphine.—Hager.

Ethyl Morphine Sulphate ($C_{17}H_{18}O_2 \cdot NOC_2H_5)_2 \cdot H_2SO_4 \cdot 5H_2O$ is soluble 1 in 9½ of water at 15.5° C. and 1 in 111 of Alcohol 90%.—J. L. Thomson, P.J. i./20,7.

Cryptopine, Gnoscopine, Meconin, Papavarine, and Xanthaline—are other constituents of opium. Papaverine has recently attracted attention therapeutically.—See Vol. I.

Laudanosine (another body) —Yields on oxidation *Lcdal *vide* Vol. I.

Cryptopine—W. H. Perkin, Trans. Chem. Soc. 1916, p. 815 (B.M.J. i./17, 836) has worked on this alkaloid to produce 5 ozs. of which 10,000 lbs. of Opium were needed. Oxidation experiments show the probable molecular arrangement of it and protopine and allied bodies.

Spasmalgin.—Combination of Papaverine, Omnopon and Atrial (a Sulphonic derivative of Atropine). In gastric pain, colic and painful menstruation.—L. i./20,506.

Hydroxycodine. Syn. Neopine. A new amorphous alkaloid found by T. and H. Smith in small quantity in the last Opium Alkaloid Mother liquors. Readily soluble in water, Alcohol, Ether and Chloroform. Hydrobromide and Hydrochloride both crystallise well.—J.C. S.T., '11,34.

Apomorphinæ Hydrochloridum.

Dott thinks the formula should be $C_{34}H_{36}N_2O_5 \cdot 2HCl \cdot 2H_2O$ (2 mols. Morphine minus 1 mol. H_2O assumed to yield apomorphine) but says further investiga-

tion necessary. He found 5.21% loss on water bath; theory requires for $2\text{H}_2\text{O}$ on his formula 5.44% loss.—P.J. ii./o8,801.

V. Paolini finds 4.2% H_2O as indicated by the formula $\text{C}_{17}\text{H}_{17}\text{O}_2\text{N}.\text{HCl}$, $\frac{3}{4}\text{H}_2\text{O}$. He finds the formula for the base to be $\text{C}_{17}\text{H}_{17}\text{O}_2\text{N}$.—P.J. ii./13,809.

A further note on formation of Apomorphine and Water Content by D. B. Dott.—P.J. i./14,164.

It is a very hygroscopic salt. We found that on drying and then placing over Calcium Chloride it reverted to the content of water originally present, viz. 3.4%.

PANCREATINUM.

THE EFFECT OF

CERTAIN CHEMICALS AND DRUGS ON THE ACTION OF PANCREATIN.

As supplementary to our work on Pepsin, we conducted experiments to determine which chemicals and "drugs" in a selected list prevent the proteolytic action of Pancreatin with certain conditions.

The substances chosen are almost identical with those in the Pepsin experiments. In the Pancreatin series, however, we omitted the acids, as these are generally held to be incompatible. W. M. Bayliss ('Nature of Enzyme Action') says Trypsin is practically inert in acid or neutral solution. Chittenden and Cummins, however, state (O. Hammarsten) that when the acid is combined with protein bodies digestion may take place rapidly when the acid combination is not in too great excess.

One quarter average doses of the substances were mixed with 5 ounces of a 3.5% Casein Solution prepared by aid of 0.35% Sodium Bicarbonate. 2 Cc. of an active Pancreatin Solution were then added. We have, therefore, the equivalent of an average dose of the "drug" in 570 Cc. (1 pint) of liquid, this bearing some relation to the conditions *in vivo*.

Milk is usually employed in standardising Pancreatin. We found it unsatisfactory and prefer the Casein method which we have arranged. Some of the chemicals in our selection cause a precipitation of the casein though the peptonising action may still proceed.

The sign + in the list indicates *complete peptonisation*—i.e., no precipitate in the liquor on acidifying with Nitric Acid a sample removed after 1 hour at 40° C.—in other words *compatibility*.

The — sign indicates that all the casein had not been peptonised as evidenced by a pp. occurring with Nitric Acid. These experiments showing, therefore, simply + and — are not so conclusive as the Pepsin series (*q.v.*) in which quantitative data are provided. The dilution used in the Pancreatin series is 20 times as great as that of List A in the Pepsin series. The incompatibles in the case of Pancreatin are more comparable with List C in the Pepsin experiments. The occurrence of a — sign with a drug in the Pancreatin series, together with a large proportion of undissolved albumen in the Pepsin series is interesting, as showing evidently marked physiological incompatibility.

The results were as follows:—

Chemical or Drug.	After 1 hour at 40° C.		Chemical or Drug.	After 1 hour at 40° C.	
Acetonum	1·5 Cc.	+	Liq. Bismuthi ..	0·6 Cc.	+
Aether	0·5 Cc.	+	„ Hamamelidis ..	1·2 Cc.	+
Aethyl Acetas ..	1 Cc.	+	„ Hydrogenii Per-		
Alcohol	4 Cc.	—	oxidi 10 vols. ..	2·0 Cc.	+
Alum	0·16 Gm.	+	„ Morphinae Hydro-		
Auri Chloridum ..	0·0005 Gm.	+	chloridi ..	0·5 Cc.	+
Caffeinae Citras ..	0·1 Gm.	+	„ Sennae Concent..	0·6 Cc.	+
Calcii Chloridum ..	0·16 Gm.	—	Lithii Citras ..	0·13 Gm.	+
„ Glycerophosph.	0·1 Gm.	+	Lycetol	0·32 Gm.	+
Chinosol	0·06 Gm.	+	Magnesium Sulphas ..	1·0 Gm.	—
Chloral	0·16 Gm.	+	„	0·13 Gm.	+
Chlorodyne	0·15 Cc.	+	Manganesii Hypo-		
Chloroform	0·12 Cc.	+	phosphis ..	0·13 Gm.	—
Cocain. Hydrochlor	0·008 Gm.	+	Methylene Blue ..	0·06 Gm.	+
Codeina	0·016 Gm.	+	Methyl Alcohol	0·25 Cc.	+
Creosotum	0·04 Cc.	+	Migralgine	0·2 Gm.	+
Cupri Sulphas ..	0·1 Gm.	—	Naphthalini Hydro-		
Dec. Aloes Comp. ..	4·0 Cc.	+	chlor.	0·2 Gm.	+
Elixir Aromaticum ..	1·0 Cc.	+	Paraldehydum ..	0·5 Cc.	+
„ Bismuthi and			Phenacetin	0·12 Gm.	+
Pepsina	1·0 Cc.	+	Phenazonum	0·15 Gm.	+
„ Papain	1·0 Cc.	+	Piperazin	0·12 Gm.	+
Ext. Cascarae Liq. ..	0·6 Cc.	+	Podophyllin	0·02 Gm.	+
„ Cinchonae Liq. ..	0·2 Cc.	+	Potassa Sulphurata ..	0·12 Gm.	+
„ Cocae Liq.	0·6 Cc.	+	Potassii Bicarbonas	0·3 Gm.	+
„ Ergotae Liq.	0·3 Cc.	+	„ Bromidum	0·3 Gm.	+
„ Hydrastis Liq. ..	0·15 Cc.	+	„ Chloras	0·15 Gm.	+
„ Ipecac. Liq.	0·3 Cc.	+	„ Chloridum	0·3 Gm.	+
„ Malti Liq.	2·0 Cc.	+	„ Citras	0·5 Gm.	+
„ Nucis Vomicae Liq.	0·03 Cc.	+	„ Iodidum	0·15 Gm.	+
„ Opii Liq.	0·3 Cc.	+	„ Permanganas	0·03 Gm.	+
„ Suprarenal Liq. ..	0·2 Cc.	+	Pyramidon	0·1 Gm.	+
„ Taraxaci Liq. ..	1·0 Cc.	+	Pyrogallol	0·015 Gm.	+
Fel Bovinum Purif. ..	0·15 Gm.	+	Quininae Hydrochlor.	0·1 Gm.	—
Ferri et Ammonii Citras	0·12 Gm.	+	„ Bi-hydrochlor.	0·1 Gm.	—
„ Perchloridum ..	0·1 Gm.	—	Saccharin	0·008 Gm.	+
„ et Quininae Citras	0·12 Gm.	+	Salol	0·15 Gm.	+
„ Sulphas	0·12 Gm.	+	Santonin	0·05 Gm.	+
Formalin	0·015 Cc.	+	Sodii Arsanilas ..	0·03 Gm.	+
Glycerin	1·2 Cc.	+	„ Cacodylas	0·015 Gm.	+
Glycosal	0·3 Gm.	+	„ Chloridum	0·3 Gm.	+
Guaiacol	0·05 Cc.	+	„ Coumaras	0·05 Gm.	+
„ Camphorate	0·12 Gm.	+	„ Methyl Arsonas	0·03 Gm.	+
„ Carbonate	0·1 Gm.	+	„ Nitris	0·05 Gm.	+
Guarana	0·5 Gm.	+	„ Sulphis.	0·16 Gm.	+
Heroin Hydrochlor.	0·001 Gm.	+	„ Thiosulphas ..	0·5 Gm.	+
Hexamethylenetetra-			Stypticin	0·01 Gm.	+
mine	0·16 Gm.	+	Syrupus Ferri Iodidi	0·6 Cc.	—
Hydrarg. Potass Iodi-			„ „ Phosphatis	0·6 Cc.	—
dum	0·0006 Gm.	+	Terebene	0·2 Cc.	+
Hydrarg. Perchloridum	0·0006 Gm.	+	Terpene Hydrate ..	0·06 Gm.	+
Hyoscinae Hydrobro-			Thymol	0·05 Gm.	+
midum	0·0002 Gm.	+	Taeobromin. Sodio		
Iodol.	0·03 Gm.	+	Salicyl.	0·16 Gm.	+
Jalapin	0·03 Gm.	+	Thiocol	0·16 Gm.	+
Liquor Ammoniae			Thiosinamin	0·03 Gm.	+
Citratis Fort	1·0 Cc.	+	Zinci Bromidum ..	0·05 Gm.	—
„ Arsenici Hydro-			„ Sulphas	0·03 Gm.	—
chloric	0·12 Cc.	+			

It will be evident that a better view of the relative incompatibility of Pancreatin with the substances in question is obtained by comparing the Pancreatin Incompatibles with the Pepsin results (Lists A and D together) thus :—

<i>Inhibit Action of Pancreatin in dilute condition</i>				<i>Result with Pepsin in Dilute concentration—'List D' and Strong Concentration—'List A.'</i>
Alum	0.16 Gm. in 150 Cc. (5 ozs.)			Compatible (List D).
Calci Chloridum	0.16 Gm.	„	„	Practically Compatible (List A).
Cupri Sulphas	0.1 Gm.	„	„	Compatible (List D).
Ferri Perchlorid.	0.1 Gm.	„	„	„
Magnesi Sulphas	1.0 Gm.	„	„	Inhibits to Extent of 35% undissolved (List D).
Manganes. Hypoph.	0.13 Gm.	„	„	Practically Compatible (List A).
Quininae HCl.	0.1 Gm.	„	„	Practically Compatible (List A).
Syr. Ferri. Iodidi.	0.6 Cc	„	„	Compatible (List A).
„ „ Phosph.	0.6 Cc.	„	„	„
Zinci Bromidum	0.05 Gm.	„	„	„ (List D).
„ Sulphas	0.03 Gm	„	„	„

Conclusions.

It will be seen that these results are very similar—the total list of incompatibles is very much on the same lines in both series. The majority of the Pancreatin Incompatibles appear in the Pepsin Lists as incompatible also, though not to so marked a degree—Alum, Copper Sulphate, Ferric Chloride, Zinc Bromide, and Sulphate were more incompatible with Pancreatin than with Pepsin. Similarly, Syrup of Ferrous Iodide and Syrup of Ferrous Phosphate were incompatible with Pancreatin, whilst they were compatible with Pepsin.

Magnesium Sulphate figures as incompatible with both ferments in the same dilutions. 'Acids' in general may here be added.

C.f. also Pepsin Results, p. 130 *et seq.* and 'Enzyme Action,' Vol. I., p. 631.

EXPERIMENTS TO DETERMINE EFFECT OF CHEMICALS ON THE AMYLOLYTIC ACTION OF PANCREATIN.

It seemed of interest to determine the amylolytic activity of a *Pancreatin which had been found to be weak in proteolytic power* and then subsequently to determine the inhibitory effect of drugs on the amyolysis.

With regard to the first point it was found that the sample of Pancreatin in question was well up to Standard when tested for amylolytic power; and a certain liquid preparation of commerce, which had strong proteolytic power, was found to be practically useless for amyolysis. *C.f.* Malt Diastase Results.

As to the second point, 0.4 Gm. of the Pancreatin, weak in proteolytic power, was mixed with 10 Cc. of Water, and added to Starch 7.5 Gm. gelatinised in water 150 Cc. (made almost transparent by boiling and cooling)—the amount of medicament having been previously added to this Starch mixture.

After 5, 15 and 30 minutes the liquors were tested with dilute Iodine Solution on the lines of the U.S. Assay Process. Results were as follows:—

		5 minutes	15 minutes.	30 minutes.
Acid	Aceto-Salicylicum 0.16 Gm.	—	—	—
„	Gallicum 0.16 Gm.	—	—	—
„	Hydriodicum Dil 0.15 Cc.	—	partial.	partial.
„	Hydrobromicum 0.5 Cc.	—	—	—
„	Hydrochlor Dil. 0.15 Cc.	—	—	—
„	Salicylicum 0.16 Gm.	+	—	—
„	Tannicum 0.16 Gm.	—	—	—
Alum (Potash)	0.16 Gm.	partial	partial.	+
Caffeinæ Citras	0.08 Gm.	partial.	partial.	+
Cupri Sulphas	0.1 Gm.	—	—	partial
Ferri Perchloridum	0.1 Gm.	—	—	—
Piperazine	0.16 Gm.	—	partial.	partial.
Potassa Sulphurata	1.3 Gm.	+	—	—
Potassii Bicarbonas	1.3 Gm.	+	—	—
Syr. Ferri Iodidi	0.6 Cc.	+	—	—
„ „ Phosph	0.6 Cc.	+	—	—
Zinci Bromidum	0.05 Gm.	+	—	—
„ Sulphas	0.03 Gm.	+	—	—

Sorensen's Test recommended. 0.02 Gm. after 1 hour's digestion should require 2 Cc. of N/5 NaOH under conditions of the test. See Pract. Phys. Chem.—Aders Plimmer, also B.M.J. i./12,584.

Measurement of relative tryptic activity by Sorensen's Method. Five specimens of Pancreatin and two of Trypsin compared.—A. R. Smith, P.J. ii./12,137.

Some commercial varieties of Pancreatin yield to peptonised milk an objectionable odour.—T. E. Tawell points out that this is due to the fact that the cheap forms of Petroleum are used in extracting fat from Pancreatin.—B.J. ii./13,570.

Muller's Trypsin Test.

A method of testing the activity of Trypsin Preparations consists in placing small quantities of the Trypsin preparations to be tested from a Platinum loop, upon a Löffler Blood Serum plate and incubating 12 hours at 55 to 60° C. In good products a depression should be made on the Serum with a dilution 1 : 1000.—Pr., Jan., 1913.

PARAFFINUM LIQUIDUM.

Off. now allows a larger range of Sp. Gr., viz., 0.860 to 0.890 (B.P. '98 was 0.885 to 0.890).

Liquid Paraffin has been largely used as an intestinal lubricant (vide Vol. I.) A light oil is not advised for this purpose:—

Viscosity of Liquid Paraffin.

Much attention has latterly been directed to this subject. The introduction of a much wider range in Sp. Gr. officially led to the wrong type of 'Oil' being employed as an intestinal lubricant. An 'Oil' with a Sp. Gr. of 0.860 is more of the nature of Petrol than Liquid Paraffin. It passes too rapidly through the system. Furthermore, it is conceivable that such a spirit could be positively injurious by reason of its caustic solvent nature.

A new element has been introduced into the examination of medicinal Liquid Paraffin, namely, the determination of its *viscosity* by the *Redwood Standard Viscometer*—an apparatus devised by the late Sir Boverton Redwood, for the proof of suitability of oils for lubricating various types of machinery.

Viscosity is undoubtedly as important as Sp. Gr., because viscosities may vary even when Sp. Grs. are the same. In a series of Liquid Paraffins examined by the 'Lancet,' viscosities at 100° F. varied from 440 to 67 seconds.

The conclusion is that the **gravity should be as high as possible, at least 880, and the viscosity at least 105.**

The meaning of this is that in the viscometer 50 Cc. of Oil takes at least 105 seconds to flow out.

A sample of a *good* Liquid Paraffin examined by the author had Sp. Gr. 0.884 and viscosity 250, while a relatively inferior one had Sp. Gr. 0.876 and viscosity 118.

Both were free from **Sulphur Compounds** and fluorescence, which are also important factors.

The B.P. **Sulphuric Acid** test should also be watched—some of the poor quality oils give a *black* colour with it.

It may also be mentioned that **Chemically Russian and American Oils differ**—the former being in general genuine Paraffins—saturated hydrocarbons as distinct from unsaturated olefines (c.f. Vol. I., pp. 63, 625), but for internal use it is doubtful whether there is any clinical difference on this score.

Wij's Solution employed with a Liquid Paraffin (variety not stated), showed I. V. *nil*—no iodine absorbed. *Soft* Paraffins on the other hand gave I. V.'s ranging from 2.8 to 12.4.—W. R. Pratt & H. L. Smith, P.J. ii./15,544.

References on the subject: L. ii./15,761,883,1108,1199; ii./16,293. P.J. i./15,389,520.

Liquid Paraffin may be used in place of Cedar Wood Oil for **lens immersion**.—Rowntree.

There is no better **mounting medium for Bacteria**. The refractive index of bacteria is said to be 1.55, Canada Balsam 1.538, Balsam in Xylol a little lower say 1.53, Distilled Water 1.336, Liquid Paraffin 1.471. In a medium exactly that of the bacteria, *e.g.*, Oil of Aniseed 1.55 the bacteria, dried, but unstained would be invisible, in Canada Balsam they would be seen, in Paraffin better and in Water best. Flagella of bacteria and spirochaetae which were known to possess same, as well as the flagella of the tubercle bacillus and *M. Melitensis* (which are commonly supposed not to possess them) were taken in some test experiments. The visibility of same (the bacteria being stained by ordinary stains, not flagella stains) depended largely on the mounting medium used. These were not easily seen in media of *very high or very low* R.I., but these media caused very rapid fading. Of all practical media Parolein was found to be best. Liquid Paraffin is, however, not so good as Cedar Wood Oil for lens immersions.—A. C. Coles.—L. i./11,877.

For pediculosis ordinary burning oil thrown over from head to heel avoiding the scrotum. The wetting being complete, the man resumes his clothing. Avoid *rubbing* or dermatitis would follow. Hundreds of cases successful with one application.—B.M.J. i./16,837. c.f. Therapeutic Index, Vol. I.

- '**Petrol**' and **Petrol Tests**.—Fractionation shows sophistication. A uniform B. Pt. Sp. Gr. to the last residue is the ideal. **A good Petrol**

has Sp. Gr. 0.680 to the last 10%, which is 0.715. The B.Pt. of this is about 75° C.—all being over at 85° C. (the last 10%). **‘Motor Spirit’** may have given fractions with larger ranges of Sp. Gr. and B. Pts.—Bailie, *Automotor Jl.*, May 23.08.

Petro is a complex mixture of the Paraffin series of the general formula C_nH_{2n+2} . The following are a few figures for members of the series:—

	B.Pt.	Sp. Gr.
Pentane C_5H_{12} (3 isomers possible)	37–39°	0.628
Hexane C_6H_{14} (5 isomers possible)	70°	0.633
Heptane C_7H_{16} (9 isomers possible)	97–99°	0.691

and so on.

The two last virtually = Petrol, but there are also small quantities of Benzol ring compounds and other complex bodies.

Exhaust gas in car, poisonings by, L. i./20,1334.

Although **Gasoline** (virtually Petrol) Vapor has an intoxicating effect the toxicity of a given amount is much less than that of Carbon Monoxide produced by its incomplete combustion in an engine. Experiments on dogs. The anæsthetic action of Gasoline Vapor is somewhat like that of Ether, but with marked convulsant effects, due doubtless to irritation of the cerebral cortex.—H. W. Haggard, *Jl. Pharm. & Exp. Therap.*, Dec. 1920.

PEPSINUM.

Off.—Pepsin standard requires that one part digests 2,500 of hard boiled egg albumen, with certain conditions.

Further Assay Methods:—

FR. CX. requires that the Pepsin shall convert 25 times its weight of dried fibrin. Pepsin 0.1, Dilute Hydrochloric Acid 1.5, Water 58.5, Fibrin 2.5 for 9 hours at 50°. Test filtrate with Nitric Acid. Pepsin Amylacée and Pepsin Lacrosee in dose 0.25 Gm. are to contain sufficient Pepsin to carry out the above test.

Hercod and Maben, comparing the official methods in various countries, suggest as an International standard 1 to 2,000 and *Assay Method* as follows:

Coagulated white of egg (obtained by boiling fresh eggs for ten minutes), pass through a No. 40 sieve, and press between two sheets of filter-paper to remove surplus moisture; place 10 Gm. in a 200 Cc. flask containing 100 Cc. of distilled water previously heated to 52° C., 0.25 per cent. absolute HCl, and 5 Cc. of a 0.1 per cent. solution of pepsin. Place the flask in a water-bath at 52° C., and digest at that temperature for two hours, stirring gently every fifteen minutes with a rotatory movement by means of a glass rod. At the expiration of two hours the albumin should be dissolved, the solution having an opalescent appearance.—P.J. ii./10,368; C.D. ii./10,371.

It is stated (Maben and Walker, C.D. Sept. 3, 1910, p. 41), that on digesting albumin with Pepsin (in acid solution) the albumin is not entirely converted into Peptone—on the contrary, firstly, Syntonin and secondly Proteose (Albumose) are formed prior to Peptone: even if the digestion is carried on for as long as 144 hours rarely “more than 45% of true peptone is in solution.”

The Syntonin can be demonstrated by neutralising the acid solution with alkali, giving a whitish precipitate.

The albumose can be shown by treating with hot saturated solution of Ammonium Sulphate.

Carmino-fibrin, prepared by washing blood fibrin with ammoniacal solution of carmine, is a dark coloured mass, easily crumbled, which yields no colour to water or 0.1% Hydrochloric Acid until the fibrin contained in it has been dissolved by a ferment; hence its use as a simple quantitative test for pepsin by noting the time required to give a pink colour equal to that of a standard or control.

THE EFFECT OF CERTAIN CHEMICALS AND DRUGS ON THE ACTION OF PEPSIN.

The following experiments which we conducted show approximately the relative inhibitory action *in vitro* which certain chemicals and drugs have on the digestive power of Pepsin. The conditions under which the experiments were conducted were as follows:

Three Gm. of Egg Albumen, prepared as for testing Pepsin (*Off.*), were placed in 30 Cc. of Hydrochloric Acid 0·2%. An average dose (in most cases) of the drug was added, followed by 1 Cc. of freshly prepared Pepsin Solution containing 0·2% of Pepsin (*Off.*). These mixtures were then incubated at 38° C. for fifteen hours, this length of time being allowed to permit of the Pepsin utilising its power to the utmost. It is to be noted that 30 Cc. of fluid is a small amount in comparison with the capacity of the human stomach, but the results are comparable, and it is evident that if the drugs in question do not interfere with peptic activity in this strong concentration, they are certainly not likely to do so when more diluted. On the other hand, if peptic activity is interfered with, there is evidence of physiological incompatibility—though it may be of less magnitude than the figures suggest.

List A.

Chemical or Drug.	Undissolved Albumen after 15 hours.	Percentage Undissolved.
	Gm.	
Acetone 6·0 Cc.	1·5	50·00
„ 3 Cc.	0·10	3·33
„ 2 Cc.	Trace	Negligible.
Acid Aceto Salicyl 0·6 Gm.	0·05	1·66
„ Aceto-Coumaric 0·6 Gm.	0·34	11·33
„ Benzoic 0·6 Gm.	0·03	1·00
„ Boric 0·6 Gm.	0·00	0·00
„ Cacodylic 0·12 Gm.	0·20	6·66
„ Carbolie 0·2 Gm.	0·20	6·66
„ Citric 0·3 Gm.	0·40	13·33
„ Coumaric 0·6 Gm.	0·30	10·00
„ Gallic 0·6 Gm.	0·15	5·00
„ Hydriodic Dil. 0·6 Cc.	0·40	13·33
„ Hydrochloric Dil. 0·35 Cc. (10%)	0·10	3·33
„ Hydrobromic 2 Cc. (10%)	0·35	11·66
„ Hypophosph. Dil. 0·5 Cc.	0·10	3·33
„ Phosph. Conc. 0·25 Cc. (66%)	0·10	3·33
„ Salicylic 0·3 Gm.	0·15	5·00
„ Sulphurosum 2 Cc. (5% SO ₂)	0·15	5·00
Æther 2 Cc.	0·05	1·66
Æthyl Acetas 4 Cc.	0·50	16·60
Alcohol 90% 15·0 Cc.	2·65	88·33
„ 90% 8 Cc.	1·00	33·33
„ 90% 4 Cc.	0·40	13·33
„ 90% 0·6 Cc.	0·24	8·00
Alum 0·6 Gm. (Potash)	2·00	66·66
Auri Chloridum 0·002 Gm.	0·00	0·00
Bismuth, see Liquor Bismuthi.		
Caffeinæ Citras, 0·3 Gm.	0·04	1·33
Calcii Chloridum 0·6 Gm.	0·30	10·00
„ Glycerophosph. 0·3 Gm.	0·00	0·00
Chinosol 0·2 Gm.	0·95	31·66
Chloral Hydras 0·6 Gm.	0·30	10·00
Chloromorphiæ Liquor 0·6 Cc.	0·10	3·33
Chloroform 0·5 Cc.	0·10	3·33
Cocainæ Hydrochloridum 0·03 Gm.	0·00	0·00
Codeinæ Hydrochloridum 0·06 Gm.	Trace.	Negligible.
Creosotum 0·2 Cc.	0·25	8·33
Cupri Sulphas 0·3 Gm.	1·20	40·00

List A—continued.

Chemical or Drug.	Undissolved Albumen after 15 hours	Percentage Undissolved.
	Gm.	
Decoctum Aloes Comp. 15.0 Cc	1.00	33.00
Elixir Aromaticum 4 Cc.	Trace.	Negligible.
„ Papain 4 Cc.	0.14	4.66
Ext. Cascaræ Liquidum 3 Cc.	0.20	6.66
„ Cinchonæ Liquidum 0.7 Cc.	Trace.	Negligible.
„ Cocæ Liquidum 3 Cc.	„	„
„ Ergotæ Liquidum 1.5 Cc.	„	„
„ Hydrastis Liquidum 0.6 Cc.	„	„
„ Ipecac Liquidum 1.0 Cc.	„	„
„ Malti Liquidum 8 Cc.	3.00	100.00
„ Nucis Vom. Liq. 0.12 Cc.	Trace.	Negligible.
„ Opii Liq. 1.2 Cc.	0.24	8.00
„ Suprarenal Liq. 0.7 Cc	0.49	16.33
„ Tarax. Liq. 4 Cc.	1.61	53.66
Fel Bovinum 0.6 Gm.	3.00	100.00
Ferri et Ammon. Cit. 0.5 Gm.	2.73	91.00
„ et Quininæ Cit. 0.5 Gm.	3.00	100.00
„ Perchloridum 0.4 Gm.	2.40	80.00
„ Sulphas. 0.2 Gm.	1.66	55.33
Formalin 0.06 Cc.	0.43	14.33
Glycerin 5.0 Cc.	0.28	9.33
Glycerin. Trypsin, 5.0 Cc.	0.40	13.33
Glycetract Calumbæ 1.0 Cc.	0.10	3.33
Glycosal 1.2 Gm.	1.12	37.33
Guaiacol 0.20 Cc.	1.51	50.33
Guaiacol Camphoras 0.5 Gm	Trace	Negligible
Guaiacol Carbolas. 0.3 Gm.	„	„
Guarana 2.0 Gm.	„	„
Helmitol 0.5 Gm.	1.76	58.66
Heroin Hydrochlor. 0.003 Gm.	0.00	0.00
Hexamethylene tetramine 0.6 Gm.	1.50	50.00
Hydrargyri Potass. Iodid. 0.0025 Gm.	0.00	0.00
„ Perchloridum 0.0025 Gm.	0.00	0.00
Hyoscinæ HBr. 0.0096 Gm.	0.00	0.00
Iodol 0.12 Gm.	Trace	Negligible
Jalapin 0.12 Gm	1.30	43.33
Liquor Ammonii Citras Fort 4 Cc.	2.30	76.66
Hydrogenii Peroxidi Liquor ('10 vol.')		
8.0 Cc.	0.00	0.00
Liq. Arsenii Hydrochloricus 0.5 Cc.	0.05	1.66
„ Bismuthi 3 cc.	0.50	16.66
„ Hamamelidis 5 Cc.	0.00	0.00
„ Morphinæ Hydrochlor 2 Cc.	Trace.	Negligible
„ Sennæ Conc. 3 Cc.	2.40	80.00
Lathii Citras 0.5 Cc.	1.80	60.00
Lycetol 1.2 Gm.	2.10	70.00
Magnesii Sulphas 4.0 Gm.	1.90	63.33
„ „ 0.6 Gm.	1.15	38.33
Manganesii Hypophosph. 0.5 Gm.	0.40	13.33
Methylene Blue 0.25 Gm.	0.19	6.33
Methyl Alcohol 1.0 Cc.	Trace.	Negligible
Migralgol 0.8 Gm.	0.20	6.66
Naphthalini Hydrochlor. 0.6 Gm.	0.00	0.00
Pancreatin 0.25 Gm.	0.00	0.00
Paraldehydum 2 Cc.	1.60	53.33
Perhydrol 2 Cc.	0.00	0.00
Phenacetinum 0.5 Gm.	0.00	0.00
Phenazonum 0.6 Gm	1.40	46.66

List A—continued.

Chemical or Drug.	Undissolved Albumen after 15 hours.	Percentage Undissolved.
	Gm.	
Phosphorus 0.0013 Gm.	0.00	0.00
Physostigminæ Sulph. 0.002 Gm.	0.00	0.00
Picrotoxin 0.001 Gm.	0.00	0.00
Pilocarpinæ Nitrates 0.003 Gm.	0.00	0.00
Piperazina (Base) 0.5 Gm.	2.45	81.66
„ (neutralised with HCl) 0.5 Gm.	0.73	24.33
Podophyllin 0.06 Gm.	0.00	0.00
Potassa Sulphurata 0.4 Gm.	2.60	86.66
„ (Neutralised with HCl)	1.90	63.33
Potassii Bicarbonas 1.2 Gm	1.70	56.66
„ Bromidum 1.2 Gm	1.64	54.66
„ Chloras 0.6 Gm.	1.14	38.00
„ Chloridum 0.3 Gm.	1.20	40.00
„ „ 0.6 Gm.	2.10	70.00
„ „ 1.2 Gm.	2.40	80.00
„ Citras 2.0 Gm.	1.66	55.33
„ Iodidum 0.6 Gm.	1.90	63.33
„ Permanganas 0.12 Gm	1.70	56.66
Pyramidon 0.3 Gm.	Trace.	Negligible
Pyrogallol, 0.06 Gm.		
Quininæ Hydrochlor. 0.3 Gm.	0.30	10.00
Saccharin 0.03 Gm.	0.42	14.00
Salol 0.6 Gm.	0.60	20.00
Santonin 0.2 Gm.	0.40	13.33
Sodii Arsanilas 0.12 Gm.	0.20	6.66
„ Cacodylas 0.06 Gm	0.13	4.33
„ Chloridum 0.3 Gm.	0.80	26.66
„ „ 0.6 Gm.	1.50	50.00
„ „ 1.2 Gm.	1.70	56.66
„ Coumaras 0.2 Gm.	2.90	96.66
„ Methyl-Arsonas 0.12 Gm.	0.40	13.33
„ Nitris 0.1 Gm.	2.40	80.00
„ Sulphur 0.6 Gm	2.50	83.33
„ Thiosulphas 2.0 Gm.	1.20	40.00
Stypticin 0.06 Gm.	Trace.	Negligible.
Syrupus Ferri Iodidi 2 Cc.	0.00	0.00
Terebenum 0.6 Cc.	0.10	3.33
Terpini Hydras 0.25 Gm	0.30	10.00
Terpinol 0.2 Cc.	0.10	3.33
Theobromina 0.2 Gm	Trace.	Negligible.
Theobrominæ Sodii Salicyl. 0.8 Gm	2.05	61.66
Thiocol. 0.6 Gm.	2.45	81.66
Thiosinamin 0.1 Gm.	Trace.	Negligible.
Thymol 0.1 Gm.	1.80	60.00
Zinci Bromidum 0.2 Gm	1.45	48.33
„ Sulphas 0.12 Gm.	1.46	48.66
Control	Nil.	Nil.

These results are interesting, as they tend to solve a vexed problem—to wit, the physiological incompatibility of a number of substances with Pepsin.

It is notable, for example, that the following apparently **do not interfere** with peptic activity to any extent:—

List B.

Acetonum, small dose.	Guarana.
Acidum Aceto-Salicylicum	Heroin Hydrochloridum.
„ Benzoicum.	Hydrargyri Perchloridum.
„ Boricum.	„ et Potassii Iodidum.
„ Cacodylicum.	Hydrogenii Peroxidum.
„ Carbolicum.	Hyoscinæ Hydrobromidum.
„ Gallicum.	Iodol.
„ Hydrochloricum.	Liquor Arsenici Hydrochloricus.
„ Hypophosphorosum Dilutum	„ Hamamelidis.
„ Phosphoricum.	„ Morphinae Hydrochloridi
„ Salicylicum.	Magnesi Sulphas. (small dose.)
„ Sulphurosum.	Methyl Alcohol.
Æther.	Methylene Blue.
Alcohol, small proportion	Migralgin.
Auri Chloridum.	Naphthalini Hydrochloridum.
Caffeinae Citras	Pancreatinum.
Calcii Glycerophosphas.	Perhydrol.
Chloromorphiæ Liquor.	Phenacetinum
Chloroformum.	Phosphorus.
Cocainæ Hydrochloridum.	Physostigminæ Sulphas
Codeinæ Hydrochloridum.	Picrotoxinum.
Elixir Aromaticum.	Pilocarpinæ Nitras
„ Papain.	Podophyllin.
Extractum Cascaræ Liquidum	Pyramidon.
„ Cinchonæ Liquidum	Pyrogallol.
„ Cocæ Liquidum.	Sodii Arsanilas.
„ Ergotæ Liquidum.	„ Cacodylas
„ Hydrastis Liquidum.	Stypticin.
„ Ipecacuanhæ Liquidum	Syrupus Ferri Iodid
„ Nucis Vomicae Liquidum	Terebenum
Glycetractum Calumbæ.	Terpinol.
Guaiacol Camphoras.	Theobromina.
„ Carbonas.	Thiosinamin

In arriving at the above conclusion we took, in most cases, 6·6%, or less *undissolved* to indicate in the conditions of the test **physiological compatibility**. The gradation of figures in respect of the different amounts of Alcohol (see Table) is particularly interesting and instructive. The fact that **Acids** in general other than Hydrochloric are seen to be compatible is of interest. The compatibility of **Chloroform** is well known to physiological chemists. Other interesting and perhaps unexpected *compatibles* are **Creosote**, **Ether**, **Guaiacol preparations**, **Mercuric Chloride** (in dose specified), **Hydrogen Peroxide**, **Sodium Arsanilate**.

The following, on the other hand, *inter alia*, appear to **prevent peptic action** if present in strong proportion:—

LIST C.

Acetonum, large proportion	Ferri Sulphas.
Alcohol, large proportion.	Guaiacol
Alkalis.	Hexamine.
Alumen.	Jalapin.
Cupri Sulphas	Liquor Ammonii Citratis Fortis
Extractum Malti.	„ Sennæ Concentratus.
Fel Bovinum.	Lithii Citras.
Ferri et Ammonii Citras	Magnesi Sulphas in large dose
„ et Quininæ Citras.	Paraldehydum.
„ Perchloridum.	Phenazonum

Piperazin (Base)
 Potassa Sulphurata (neutralised with
 Hydrochloric Acid.)
 Potassii Bromidum
 „ Chloras
 „ Chloridum
 „ Citras.

Potassii Iodidum
 „ Pernianganas.
 Sodii Chloridum,—a considerable
 amount.
 „ Nitris.
 „ Sulphis.
 „ Thiosulphas.

Amongst this series of particular interest are the results with **Alcohol, Sodium and Potassium Chlorides** (the Potassium Salt no better than the Sodium analogue), also **Hexamine** and **Magnesium Sulphate**. But one must take into account the comparatively strong concentrations in which we were working (an average dose of the drug in 30 Cc. of Peptonising Fluid) and the fact that such concentrations would hardly occur in practice. Nevertheless, as already stated, the evidence of these physiological incompatibilities is of value especially when the results *are compared* with the previous series, *i.e.*, the *relatively compatible* medicines.

We next tested whether the drugs that are incompatible in strong proportion (average dose in 30 Cc.) would *exhibit similar effect when present in a volume of Liquid bearing more resemblance with that encountered in the human digestive tract*.

For this purpose the drugs required from "List C" with some additions from "List A" were treated as follows:—

14.2 Gm. Egg Albumen prepared as before were placed in 150 Cc. of Hydrochloric Acid 0.2% containing 10 mgr. of Pepsin and $\frac{1}{4}$ of an average dose (in most cases) of the drug was added. In other words, the conditions of the test are identical with those at the outset except that we have here the equivalent of the average dose of the drug approximately in a *pint* of the Liquor, whilst previously it was present in about an *ounce* (30 Cc.).

The results were as follows:—

LIST D.

Chemical or Drug	Undissolved Albumen after 15 hours	Percentage Undissolved
Alum, 0.15 Gm.	Nil.	Nil.
Cupri Sulphas 0.1 Gm.	Nil.	Nil.
Ext. Malti Liq. 2 Cc.	Nil.	Nil.
Fel Bovinum Purif. 0.15 Gm.	0.4 Gm.	2.8%
Ferri et Ammon. Citras 0.13 Gm.	Nil.	Nil.
„ et Quinin. Citras 0.13 Gm.	Nil.	Nil.
„ Perchloridum 1.0 Gm.	Nil.	Nil.
„ Sulphas. 0.05 Gm.	Nil.	Nil.
Helmitol 0.15 Gm.	Nil.	Nil.
Hexamethylentetramine 0.15 Gm.	1.7 Gm.	11.9%
Liq. Ammon. Citrat. Fort. 1 Cc.	11.5 Gm.	81%
Magnesi Sulphas 1 Gm.	5 Gm.	35%
Paraldehydum 0.5 Cc.	Nil.	Nil.
Phenazonum 0.15 Gm.	Nil.	Nil.
Piperazina (base) 0.15 Gm.	Nil.	Nil.
Potassa Sulphurata 0.1 Gm.	0.5 Gm.	3.5%
Sodii Nitris 0.02 Gm.	Trace.	Negligible
„ Sulphis 0.15 Gm.	Nil.	Nil.
„ Coumaras 0.05 Gm.	Nil.	Nil.
Thiocol 0.15 Gm.	Nil.	Nil.
Zinci Bromidum 0.05 Gm.	Nil.	Nil.
„ Sulphas 0.02 Gm.	Nil.	Nil.
Control	Nil.	Nil.

Conclusions.

Dilution of the chemical or drug, therefore, plays a very important part in the matter. All the incompatible substances indicated in 'List C' were under exceptional circumstances of concentration.

'List D' shows that in the presence of a larger volume of diluent fluid the substances incompatible with Pepsin are greatly reduced in numbers, but the result in the case of **Magnesium Sulphate** is of peculiar interest. The proportions of undissolved albumen shown by the other substances in this list are negligible, or may be chemically explained.

It must not be forgotten that nature might compensate effects produced by chemicals in a manner which it is impossible to imitate in such experiments.

At the same time it must not be overlooked that under certain conditions, *e.g.* ill health, or an empty stomach, the volume of diluent fluid might be greatly reduced, hence the 'List A,' and in particular 'List C,' will be of value to the physician, *firstly*, as showing where incompatibility with the patient's peptic activity may be expected, and *secondly* when prescribing pepsin preparations, as showing what to avoid. These results may be compared with the analogous Pancreatin data.—*v.* also Malt, p. 91 *et seq.*

See also 'Enzyme Action' Vol. I. p. 631.

REFERENCES.—Enzymes, Proteins, Milk and Meat products.—Allen, 4th Edn., 1914, Vol. VIII.; also W. M. Bayliss & O. Hammarsten.

PINUS.

Oleum Terebinthinæ.

Lævo-Pinine or **Terebentene** of Berthelot is obtained by Fractionation of French Oil of Turpentine as a colourless mobile liquid of characteristic odor. Sp. Gr. 0.8767 at 0° C. and 0.8619 at 17.9° C.

Dextro-Pinene or **Australene**, the principal constituent of American Turpentine has the same Sp. Gr. and boiling point, etc., as the French. O.R. is stated to be + 2.15°.—Allen, Vol. II., Part II., I., p. 262.

Russian Turpentine Oil.—Authentic samples contain 40 to 70% distilling between 155° and 160° C. and consisting chiefly of Pinene. The oils arriving in the London markets have these 'middie runnings' removed.

For MAKING DISINFECTANTS it may not be of importance to have a large amount of hydrocarbon of relatively low boiling point. Useful details tabulated.—E. J. Parry, C.D. ii./12,340,855; Y.B.P., 1913, 93.

Indian Turpentine from *P. Longifolia*, Constituents of.—J. L. Simonsen J. C. S. May, '20, 570.

Oregon and Colorado Douglas Fir Oils from trees grown in Britain. Geraniol the chief odorous constituent of the first. The odour of the other appears due to the large % of pinene and bornyl acetate.—C. T. Bennett, P.R. 1920, 218.

PIX LIQUIDA.

Stockholm Tar is a peasant-made article; this tar can be separated by fractional distillation into three principal fractions: (1) A watery portion containing pyroligneous acid, Methyl alcohol or wood naphtha, and acetone; (2) **light oil of tar** which contains some of these substances Toluol, Xylol, and other hydrocarbons of that series; and (3) **heavy oil of tar** which contains phenols, creosol and gualacol. The redistillation residue is ordinary block pitch. It has been arranged to define wood tar made by burning the roots of the Swedish pine tree (*P. Sylvestris*) in the peasant way—so-called

'Dalbrand Tar' as 'genuine Swedish peasant made Tar' and that 'Factory Tar' of Swedish origin shall in future be called '*Swedish Kiln Tar*.'—C.D. ii./13,331. See also D. McEwan., C.D. i./11,264.

Rectified Oil of Tar.—One gallon of Stockholm Tar yielded only a few ounces of oil with Sp. Gr. 0.921, but American Wood Tar Oil yielded nearly 40% of a brown oil with characteristic tar odour having Sp. Gr. 0.920. This redistilled with soda gave a colourless oil with faint Terebene odour and Sp. Gr. 0.881 and flash point 124° F. Commercially it is made from imported tar oil from Russia, Sweden and America by distilling and refining here. E. J. Millard, P.J. i./18,28.

Oleum Cadinum.

The following **Characters and Tests** are suggested:—

A vegetable tar obtained by dry distillation of *J. Oxycedrus*, of brownish red colour, transparent, clear and homogeneous aspect, has a wood-smoke-like odour, with a density inferior to water. It is almost *insoluble* in Water, but gives it an acid reaction, partly soluble in cold Alcohol, completely soluble in hot Alcohol (90%), in Ether, Chloroform and Carbon Bisulphide. The acidity expressed as Acetic Acid must not exceed 1.5 per 100 Cc. It must be free of other Tars and particularly not give the **Copper Acetate Test for foreign Wood Tars and Resins**.—Shake out with Petroleum Ether, filter and shake filtrate with equal volume of 1% solution of Copper Acetate; the Petroleum layer is coloured green if wood tar be present.—Perfumery and Essential Oil Record, April, 1911.—P.J. i./11,567. A test on these lines is now adopted, *Off.*, to ensure absence of *Pine Tar*.

We found on testing an assumed genuine sample, which gave no indication by itself, that *at least* 20% of Wood Tar (Stockholm) had to be added to give a definite green color to the dark supernatant liquor. There was no appreciable difference between the sample and the same adulterated with 10% of Stockholm Tar. Oleum Betulæ Pyroligneum gave a deep olive green color. Creosote, Phenol and Oleum Picis Rectificatum were tested and found to give no colour at all.

PLUMBUM.

Lead Poisoning.

Lead poisoning amongst yarn workers.—B.M.J. i./06,310.

Lead poisoning and the race.—Amongst a host of facts and fancies put forward, the following appears. Where (in Hungary) death from convulsions in early infancy rarely occurs, epilepsy is found later on to be more frequent in the children of potters than in those of non-potters.—B.M.J. i./11,1096.

Lead poisoning in all forms well treated by Calcium Permanganate in doses of $\frac{1}{2}$ grain.—B.M.J., May 14/10,1166.

English Potteries, Lead Poisoning in, Home Office Report on.—B.M.J. ii./11,44. See also *Nat.*, Dec. 29, 1910, p 273—a review on dangers attendant on the use of Lead and injury to health from dust and other causes in the manufacture of earthenware and china, etc. "It cannot be said that any real progress has been made. Although a large amount of earthenware can be made without the use of any lead, and even in the cases where lead must be used, it has been proved that the lead may be so combined that it is practically innocuous, the manufacturers as a body have hitherto resisted any attempt to prescribe a schedule of articles which should be made with leadless glaze, or to bind themselves to use glazes in which the lead is in an innocuous form. They demand unrestricted liberty to use any materials they think necessary for their purposes. The loud cry of "foreign competition" is sufficient to drown the still small voice of pity on behalf of the workers. . . . Lead glaze is the main source of the evil. The net upshot of the inquiry is that the whole position is not one whit ameliorated; the operatives apparently are still to remain the victims of lax surveillance or of indifference, and of official non-interference. If the manufacturers' claim for unrestricted liberty is to be allowed they must be made to feel the responsibility they thereby incur by far more stringent measures than have hitherto been brought to bear upon them." Anti-dust measures essential.—In industries using lead where much dust occurs lead poisoning is frequent,—the main avenue of entrance of the poison being the lungs.—T. M. Legge and Sir K. W. Goadby — B.M.J. ii./12,1712; L. i./13,183.

Determination of Lead in Lead Salts—Lead Acetate and Liquor Plumbi Subacet. Fort.—R. L. Morris, C.D. '19, 242.

Soluble lead in Casserols.—H. Masters, L. i./20, 1394.

PODOPHYLLI INDICI RHIZOMA *Off.* See also Vol. I. p. 655 (*Podophyllum Emodi*.)

Physiologically *P. Emodi* is quite as active as the American *P. peltatum*. Picropodophyllin to the extent of 5.43% was obtained from Indian root collected after flowering, corresponding to an equal weight of Podophyllotoxin (with which it is isomeric). The resin yield was 10.79%—indicating a proportion of 50.3% of Picropodophyllin, whilst that in *P. peltatum* averages only about 20—25%. Picropodophyllin is not an actual constituent of the drug, but is formed by decomposition of Podophyllotoxin, which, together with Podophyllo-resin, an indefinite amorphous substance, represents the activity of the drug. 'Fall-dug' *P. peltatum* is preferred in America—Umney, P.J. ii./11, 156; C.D. ii./09, 385.

T. A. Henry says action of both is due to Podophyllotoxin (purgative) and Podophyllo-resin (purgative and cholagogue). The Indian is richer in the former. Estimation process for Podophyllotoxin.—J.C.S., 1898, 73, p. 209. Previous references on this subject.—Y.B.P., 1892, p. 398. C.D. ii./09, 487, 522.

P. Emodi roots from the N.W. province of India gave 11.07 and 11.17% total resin. The proportion of Podophyllotoxin was in the first case 4.7% in the other 3.1%.—P.J. ii./12, 579.

PODOPHYLLI RESINA.

Reaction of *Podophyllum Peltatum* and *P. Emodi* Podophyllins towards Ammonia is of interest. If 0.5 Gm. of Resin be well stirred with 5 Cc. of Dilute Ammonia and 5 Cc. of water, and after 20 minutes the solution be filtered the residue washed and dried near 100° C., should not weigh more than 0.13 Gm., i.e. 26% if the resin has been made from *P. Peltatum*.—D. B. Dott, P.J. ii./18, 318 (per Y.B.P. 1919, 99).—c.f. *Off. Test*.

POTASSIUM.

Alcoholic Solution of Potassium Hydroxide Solution for analytical work.

Dissolve required amount of Potassium Hydroxide in its own weight of water and pour the solution when cold into Alcohol 95% about 900 Cc. with constant shaking. Dilute with Alcohol to 1000 Cc., mix and set aside until the oily drops of 'Aldehyde resin' have separated. Decant twice.

Potassii Bromidum.

Solubility found to be 72.56 Gm. in 100 Gm. of water. The solubility is increased by the addition of Bromine.—A. F. Joseph, J.C.S. Apl. '20, p. 377.

DETERMINATION OF CHLORIDE IN.—In the Silver Nitrate titration method it is more accurate to add excess of silver nitrate and determine excess with standard sulphocyanide solution than to use potassium chromate. It is, however, better to oxidise the hydrobromic acid in acid solution with an oxidising agent, e.g., ammonium persulphate or lead peroxide. The hydrochloric acid being unaffected by these can be titrated with silver nitrate solution.—Caspari.

The B.P. figure on titration on the dry salt assuming that nothing else is present other than Potassium Chloride indicates 98% pure.

0.5 Gm. of Potassium Bromide	requires	42.01	Cc. N/10 AgNO ₃
" Potassium Iodide	"	30.125	" "
" Ammonium Bromide	"	51.04	" "
" Sodium Bromide	"	48.58	" "
" Sodium Iodide	"	33.35	" "
" Ammonium Chloride	"	93.5	" "
" Sodium Chloride	"	85.53	" "

As an example: if 0.5 Gm. Sodium Bromide dry required 49.07 Cc. N/10 AgNO₃ the NaCl content would be $\frac{(49.07 - 48.58) 100}{85.53 - 48.58} = 1.4\% \text{ NaCl}$.

—Based on some figures in Evans' Anal. Notes, 1914—1919. See also A. J. Jones, C.D. '19, 1150.

Fr. Cx. Supp. has the following test for **Chlorides**:—

Distill a mixture of 5 Cc. of 10% Potassium Bromide solution with a solution of equal parts by weight of sulphuric acid and water and 10 Cc. of saturated Potassium Permanganate Solution into a tube placed in cold water and containing 10 Cc. of the following:

Saturated Aniline Water 100 Cc.

Water saturated with ortho-Toluidine 20 Cc.

Acetic Acid (98%) 30 Cc.

A white precipitate will form, and if the salt contains a notable amount of Chloride the liquid will assume first a blue and then violet-red colour. The latter should not occur in the official salt, at least within 15 minutes.

Potassii Percarbonas, $\text{K}_2\text{C}_2\text{O}_6 \cdot \text{H}_2\text{O} = 216.226$.

White crystals, soluble in water, giving off oxygen. Used chiefly as 'Anti-hypo' in photography, also for decolourising instead of Sulphuric Acid in Ziehl Neelsen's method of staining *Bacillus Tuberculosis*, q.v.

Potassii Cyanidum.

Potassium Cyanide $\frac{1}{2}$ grain made into a Pill with soap or other 'floating' material and colouring matter for tinting water forms a good method of killing the larvæ of mosquitoes (*Culex pipiens*) in pools, 1 in 300,000 is said to kill in a few hours.—B.M.J. ii./11, 712.

Potassii Chloras.

Schulze's Maceration Mixture.

A mixture of Potassium Chlorate 10 (moistened with water) with Nitric Acid 40; or a Solution of 0.06 Potassium Chlorate in Water 100 Cc. and 1 Cc. of Nitric Acid. For separation of muscle fibre in animal, and ligneous tissue in vegetable histology.

Potassii Metabisulphis $\text{K}_2\text{SO}_3 \cdot \text{SO}_2 = 222.32$. **FR. Cx.**

Anhydrous Crystals soluble in 2 parts of water. Treated with acid it liberates about 52 to 57% Sulphurous Anhydride. (Fr. Cx.).

Manufactured by passing Sulphurous Anhydride (SO_2) into Potassium Carbonate until saturated. The metabisulphite is then precipitated with Alcohol. This salt has a similar action to ordinary sulphite in preserving Pyrogallol Acid from oxidation and preventing the staining of gelatin films. It has the drawback, however, that on oxidation free Sulphuric Acid is produced, requiring an extra amount of alkali to neutralise it.—(P.J.F. 1904). The Sodium Salt has analogous composition.

Potassii Permanganas.

In titrating Potassium Permanganate Solution containing Nitric Acid with Sodium Arsenite, the latter has a reducing value greatly in excess of that shown when no acid is present. A Manganic compound is probably formed.—Abst. Ann. Rep. Chem. Soc. 1919 (Vol. XV.), p. 135.

Potassii Tartras Acidus.

Cream of Tartar Substitutes.—These are usually Calcium Acid Phosphate. A sample examined by Evans was a mixture of Cream of Tartar with Sodium Acid Sulphate, but in such proportions that the whole of the Tartaric Acid would be liberated with the Cream of Tartar in solution, with an excess of about 10% NaHSO_4 still remaining.

Another sample was a mixture of 'dry' Calcium Acid Phosphate and Sodium Chloride.

PRUNI VIRGINIANÆ CORTEX.

Identification of various Spurious Cherry Barks. *P. Avium* is paler; taste bitter and astringent. Almond odor scarcely perceptible. *P. Pennsylvanica*, red brown, taste scarcely bitter. *P. Virginiana*. The bitter almond flavour is more perceptible than in any except *P. Serotina*.—Holmes, P. J. i./09, 192.

The bark yields 0.075% of its weight HCN.—B.C.D. ii./09, 131.

Chemical examination of a species of *Prunus*, said to be closely allied to *Prunus emarginata*. The constituents, amongst which is Prunetin, a new dihydric phenol $C_{16}H_{12}O_6$, appear to bear no relation to those known to be in *P. serotina*—this substitute for the genuine article differs in that when moistened with water there is no formation of Benzaldehyde and Hydrogen Cyanide as with the genuine bark —P.J. ii./10, 604.

Syrupus Pruni Virginianæ.

Hallaway finds the *Off.* method extracts 35%, Cline's 50%, Beringer's (with Glycerin), about 70% of the hydrocyanic acid. Glycerin extracts Tannin. Cline's process—which consists in macerating the bark 2 to 4 hours at 60° C., then percolating, adding Glycerin to the percolate and finally dissolving the sugar, is thought best. This reduces the Tannin content and increases the HCN, the enzyme being more active at the higher temperature, but even in the strongest syrup the HCN strength is only 0.008 per cent., or roughly 1/13 the strength of Cherry-Laurel Water.—P.J. i./09, 798.

QUININE and other CINCHONA ALKALOIDS.

The complete **Synthesis of Quinine** is being gradually reached. Quinicine (Quinotoxine) has been converted into Quinine. (When Quinine and Cinchonine are heated with dilute Acetic Acid they are converted respectively into Quinotoxine and Cinchotoxine). The reverse change has been accomplished.—Ann. Rep. Chem. Soc. 1919 (Vol. XV.), p. 113.

Cinchona Febrifuge.

Malarial fever should be regarded not as one disease but a group of three different fevers due to three distinct parasites, and two at least of these require different alkaloids of Cinchona Bark.

The cure rate produced by Quinine is 90% or over in malignant tertian cases, 20 to 30% in benign tertian and under 20% in quartan infections.

Cinchona Febrifuge.—A preparation containing the total alkaloids from Cinchona Bark made at the Government factories in India issued in $3\frac{1}{2}$ grain tablets.

The composition is :—

		Per cent.
Crystallisable alkaloids	{ Cinchonine ..	18.58
	{ Cinchonidine ..	5.84
	{ Quinine ..	7.4
	{ Quinidine ..	22.83
Non-crystallisable alkaloids ..	" Quinoidine " ..	29.12
Ash		16.23

The tablets contain Magnesium Sulphate to assist in manufacture, hence the large amount of ash. Those made by the author do *not* contain this addition.

In benign tertian cases it is better than Quinine. Benlgn tertian is responsible for about 50% of the infections in India and in England among the troops returned from the tropics it is practically the only malarial infection seen.

The crystallisable alkaloids are the important ones from the therapeutic point of view; the non-crystallisable as contained in the **Laverain** remedy were non-effectual; all cases treated with it relapsed.

Quininc can be dismissed as the active constituent—it is only present to the extent of 7.4% in Cinchona Febrifuge and as already stated it produces a low cure rate in benign tertian infections.

Cinchonine resulted in relapses: it is toxic and badly tolerated.

Tests were made with Quinidine and Cinchonidine. **Quinidine Sulphate** 10 grains *per os*, twice daily for 21 days gave cure percentage 62.9.

Cinchonidine Sulphate gave cure percentage 63.1.

It is clear that the efficacy of the total alkaloids is dependent largely on the **Quinidine** content or the **Cinchonidine-Quinidine** mixture.

The parasitocidal action of the alkaloids depends on groupings in the molecular complexes—these are ably detailed in the paper to which reference must be made.

The laevorotatory alkaloids Quinine and Hydroquinine have a specific action on the malignant tertian parasite while the +rotatory alkaloid Quinidine (Hydroquinidine not as yet tested) is more powerful than Quinine in its action on the benign tertian parasite. Both these are much less toxic to man than Quinine.

The general conclusion is that Quinine is specific for the *malignant tertian* while Quinidine is best so far tested for the benign tertian.—Maj. H. W. Acton with chemical notes by H. King, L.i/20,1257.

Maj.-Gen. Hehir in praising Maj. Acton's paper criticises some points. He finds benign tertian forms probably **over 75%** of cases met with and not 50%.—L. i./20,1382.

M. Nierenstein also writes on the importance of Maj. Acton's findings (that whilst the -rotatory Quinine is specific for malignant its + isomeride Quinidine is best for benign tertian). He finds that if a 10% solution of Quinine Sulphate is heated 1 or 2 hours the solution turns dark and its specific rotation falls from -164 to -43° with formation of Quinotoxin probably. If the solution is heated, however, in the presence of Carbon Dioxide or Hydrogen the rotation alters from -164 to $+58^\circ$. In this latter case the Quinine is perhaps partly isomerised to Quinidine.—L. i./20,1386.

Quinine prophylaxis is a *so-called* preventive measure. The late J. C. McWalter at the Cambridge B.M.A. Meeting, 1920, exploded the doctrine that Quinine *prevented* malaria. Capt. Cecil Alport in "Malaria and Its Treatment" shows that the treatment at Salonika was a colossal and expensive failure. A good mosquito net is the best preventive.

A very interesting account of the introduction of **Cinchona Cultivation** from Peru into India and the cultivation of C. Calisaya (from the seed of a native Indian tree) in Java in 1852 by the Dutch. The Indian Administrators refused the seed which was then sold to the Dutch. They realised their mistake, however, in 1861 and started cultivation, but it was badly managed. In 1916 the great war showed the error of allowing a friendly Neutral to have monopoly in a *bark rich in Quinine*. Attention is again drawn to Maj. Acton's work showing that total alkaloids are as good as Quinine and Indian bark supplies an equivalent amount of these. It was *bark* and not Quinine that started the fame of Cinchona from Peru.—M.D., L.P.S.I., C.D. 1920, 1447.

The medical profession is to blame for spreading the superstition that Quinine could prevent or cure malaria. 80% of the men who went to Salonika contracted malaria. Each case costs the taxpayer £1,000 for treatment. The cost of malarial disease incurred during the war was 50 millions a year, all due to the mid-Victorian superstition. The consensus of the discussion (B.M.A. Cambridge meeting) was that *Quinine had failed*.—Abst. C.D. '20,966.

Excretion of Quinine in treatment. There is no appreciable difference between the bi-hydrochloride salt given *per os.*, intramuscularly or intravenously or by the first two combined. There is further no great difference in excretion of acid hydrochloride or hydrochloride or hydrobromide or acid hydrobromide or sulphate if given orally.—M. Nierenstein, Bristol University, abst. C.D., 10, 965.

RHEI RADIX.

The active principle of rhubarb is a non-glucosidic resin. The anthraquinone derivatives previously stated to be active are entirely devoid of purgative action.—Tutin and Clewer, J.C.S., 1911, 99,946; P.J. i./13,403. see also P.J. i./07,587, i./11,529. *Rheum Palmatum*, the source of Medicinal Rhubarb.—P.J. i./11,529.

According to P.G.V. should yield 35% extract on macerating 24 hours. with a mixture of equal parts alcohol and water.

POWDERED RHUBARB, Standards suggested.—12 per cent. of ash on the air-dried drug, and 35 per cent. of extractive.—E. T. Brewis and H. Deane, P.J. ii./13,146.

SACCHARUM.

Lumps of *Pure Cane Sugar* rubbed together in the dark produce luminosity.—B.M.J. i./11,752.

Cane Sugar may (in the absence of a polarimeter) be approximately estimated by heating 1 Gm. of the same in 50 Cc. of water, to which 10 drops of hydrochloric acid have been added, for half an hour on a water bath. The solution is then cooled and neutralised with soda and made up to 100 Cc. with water, and the Invert Sugar thus formed is estimated with Fehling's Solution, 1 Cc. of which is approximately equivalent to 0.005 Gm. of Invert Sugar, the calculation being on the basis that 360 of Invert Sugar represent 342 of Cane Sugar.

Polarimeter.

U.S. requires the O.R. at 20°C. in a solution containing the equivalent of 26 Gm. of sugar (previously dried to a constant weight at 105° C.) in 100 Cc. of water and using a 200 mm. tube to be not less than + 65.9°.

Decomposition products of sugars as affected by various oxidising agents. Formic Acid, a very small quantity of acetaldehyde and apparently glycuronic acid formed.—L. ii./11,1418.

SAPONES.

The following is the approximate composition of Pharmaceutical Soaps.—W. H. M.—B. & C. D. ii./94,575.

Sapo Animalis, Curd Soap. Principally Sodium Stearate; made with Sodium Hydroxide and a purified animal fat consisting principally of Stearin:—Fatty Acids 60%, Combined Alkali 9%, Uncombined Mineral Matter 2%, Water 30%. Limit Test for Alkaline Hydroxide and Carbonate and free fatty acid are imposed for this and

Sapo Durus (Hard Soap). Castile Soap is principally Sodium Oleate. Manufactured with Sodium Hydroxide and Olive Oil:—Fatty Acids 60%, Combined Alkali 8%, Uncombined Mineral Matter 2%, Water 30%. It is soluble about 1 in 20 in water.

Sapo Medicatus, P.G.V., Ph. Ned. (Full directions for making are given).

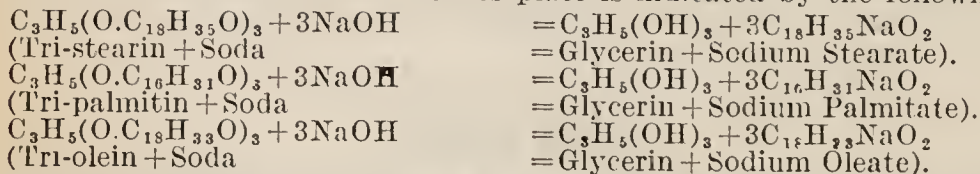
White Castile Soap and Mottled Castile Soap are trade varieties. **Mottle** is produced by adding iron or residues and scrapings of the lye tanks.

Sapo Venetus (Syn. *Savon de Venise*) similar to *Savon bleu ou Marbre* is a mottled Castile Soap.

Sapo Mollis, Sapo Viridis, Soft Soap, consists principally of Potassium Oleate. Manufactured from Potassium Hydroxide and Olive Oil:—Fatty Acids 45%, Combined Alkali 8 to 11% (reckoned as K₂O), Insoluble Mineral Matter 1.0%, Water 35 to 45%, Matter insoluble in Alcohol 3% allowed (i.e. Potassium Carbonate and Insoluble Soaps).

In soap-boiling caustic soda of high purity, 96-98%, is used for the best varieties. The lye employed (into which the melted fat is poured) has Sp. Gr. 1.075. Boiling proceeds with occasional further addition of lye.

The chemical reaction which takes place is indicated by the following:—



The soap thus produced is salted out with salt, and the glycerin formed is recovered as much as possible from the spent liquor. It is essential to ensure that the fats have been thoroughly saponified, as also that no marked excess of alkali is introduced. The next step is to clarify the soap by boiling with a fresh supply of water from any insoluble soaps, e.g., Lime and Magnesium Salts of the acids indicated above. The "nigre" containing these impurities subsides in this manner to the bottom of the vessel. The soap is then allowed to slowly cool and "settle." When cooled to 165° F. it is removed to the frames to solidify. Here it remains for a month to consolidate, and drain through apertures in the sides of the containing vessel before being cut up.

Potassium Combined with saturated fatty acids, *e.g.* Palmitic and Stearic, yield hard soaps while the unsaturated acids, *e.g.* Oleic, yield soft soaps.

Marine Soaps are made from coconut Oil and Palm Nut Oil. These oils contain, combined as glycerin esters, mainly lauric and myristic acids with some palmitic and oleic. They also contain Caproic, Caprylic, and Capric Acids. The presence of the three last mentioned is of importance because they render a soap made with coconut oil not easily salted out by sea water.—Prof. H. L. Smith, P.J. ii./15,33.

For **Toilet Purposes** special soap bases are employed containing a large proportion of stearates (tallow). A proportion of palm oil is generally combined with the tallow.

The soap ultimately is converted by machinery into ribbon-shaped shreds, it is perfumed and after other treatment is stamped in moulds.

For **Shaving Soap** it is necessary to employ fats—'strong' tallow—with a high melting point.

Pure Potassium Palmitate makes an excellent shaving soap, but it is improved by incorporating a little glycerin. Sodium Palmitate and Sodium Stearate are not suited—they are not sufficiently soluble.—Prof. H. L. Smith, P.J. ii./15,33.

Shaving Paste with pearly lustre can be made with beef tallow and Potassium Hydroxide, replacing $\frac{1}{6}$ of the KOH with Sodium Hydroxide—*ibid.*

Ordinary Household soaps are made with vegetable oils of light gravity.

Good average soap can be produced by saponifying vegetable oils, such as those of Cottonseed, Palm, or Coconut (of this the best variety is known as "White Cochin" Oil, the second as "Ceylon" Oil); but these oils containing a large proportion of the Oleic Ester produce more soluble, *i.e.*, wasteful soaps.

The use of RESIN in household soap is not injurious. The addition of the resin renders the soap smooth and prevents efflorescence. Further, the cleansing 'odour' imparted by the resin is appreciated. Yellow bar soaps contain some 10 to 25%. Its chief *raison d'être* is probably cheapness. It is not, however, suitable for toilet purposes, and a large admixture cannot be allowed. Occasional additions to common soaps are chlorophyll, sodium silicate and French Chalk.

Sodium Silicate has latterly come much into use. Some remarkable data are given by Prof. Smith—*ibid.*

Transparent Soaps are made by setting from methylated spirit. Many contain resin and sugar (as much as 20% of each).

In Germany manufacturers have the privilege of using pure spirit with 1 Kilo of Castor Oil and 400 Cc. of Soda Solution per 100 litres of Spirit to 'denature'—C.D. ii./o6,718. It is stated that in the manufacture of transparent soap with methylated spirit only about $\frac{1}{2}$ the spirit is recovered—the rest is lost in drying.

Toilet Soaps.—Examination of a large number showed little adulteration. Free *alkali* is comparatively rare.

The **Valenta figure** records the temperature at which a mixture of equal volumes of Acetic Acid and Fatty Acid result in a uniformly clear and bright solution. The majority of the figures obtained and melting points, *etc.*, approach those of Palm and Coconut Oils.—L. i./14,52.

Fatty Acids.—New method of determining.—H. F. Slack, P.J. ii./15,696.

Saponification Equivalents of Fats and Oils.

The *Saponification Number* or Köttstorfer's Number is the number of milligrammes of Caustic Potash which the fatty acids contained in 1 Gm. of the fat (free from moisture) are capable of neutralising. To 1.5 to 2.0 Gm. of the purified and filtered specimen for examination contained in an Erlenmeyer flask of about 200 Cc. capacity add 25 Cc. of N/2 Alcoholic Caustic Potash. Warm half an hour on water-bath with reflux condenser, with occasional rotation, add a little phenolphthalein solution and titrate excess of alkali with N/2 Hydrochloric Acid. Conduct a control using the alkali alone.

The difference in the number of Cc. of N/2 Hydrochloric Acid required to neutralise in the control and the actual test is converted into the number of mgr. of KOH consumed by the amount of the fat or oil originally taken and the result is expressed in equivalent of 1 Gm. of the specimen.

Saponification Numbers :—

Adeps 195—203.

Adeps Lanæ 90—102.

Oleum Adipis (U.S.) 195—197

Oleum Amygdalæ 191—200.

Oleum Gossypii Seminis.

191—196.

Oleum Lini 187—195.

Oleum Morrhuæ 175—185.

Oleum Olivæ 191—195.

Oleum Ricini 179—180.

Oleum Theobromatis 188—195.

Oleum Tiglii 212—218.

Solution of Potash in Propyl Alcohol suggested to replace Potash in ordinary Alcohol.—P.J. ii./11,9.

For Iodine Number of Fats, see p. 85.

SCAMMONIÆ RESINA.

Scammony Resin is now a mixture of resins from Scammony root or from Orizaba Jalap root, ***Ipomœæ Radix***. Off. (*Ipomœa Orizabensis*), entirely soluble in Alcohol (90%). Not less than 75% soluble in ether. Tests are given for absence of certain foreign resins, especially Colophony.

In the testing of Scammony Resin for solubility in ether it is best to macerate 6 hours 3 to 4 Gm. of the resin finely powdered in 30—40 Cc. of ether in a short, wide-mouth flask. Filter off and weigh insoluble matter and give percentage on the dry resin.

U.S. requires not less than 95% soluble (Distinction from *Jalap Resin* and *Resin of false Scammony*). Tests are also given for Gualacum and Resin.

Saponification Values characteristic of both the resins—of *C. Scammonia* and *Ipomœa Orizabensis*—enables detection of the Mexican Scammony. In the case of the former the Saponification No. is in the neighbourhood of 238, and in that of the latter a little below 190. For quantities and method of work consult Am. Jl. Ph., Mar., '09, p. 105. See also P.J. i./12,285.

SENNÆ FOLIA.

Senna Leaf Constituents.—An examination of Tinnevely leaves, leaves grown at Lima (botanically identical) and Alexandrian leaves, yielded (1) Salicylic Acid (not previously noted as a constituent), (2) Rhein $C_{15}H_8O_6$, previously only known as a constituent of rhubarb, (3) Kæmpferol, (4) Aloe-Emodin and other bodies. The purgative action is in part due to the Aloe-Emodin and other bodies.—F. Tutin, P.J. ii./13,741; C.D. ii./13,743.

Powdered Senna.—20 samples found free from actual adulteration, but some of them had been made from low-grade material, as shown by the absence of green colour and the presence of stalks and sand. Easy for the pharmacist to determine the quality of senna powder microscopically.—Prof. Greenish, P.J. i./13,365,370.

Senna and Gum Arabic. Account of French Government Expedition by Perrot & Alland in the Sudan with a view to acquiring knowledge for cultivation in the French African Colonies.—Prof. Greenish, P.J. ii./20,488.

SINAPIS SEMINA.

Black Mustard contains the glucoside Sinigrin, this is—

Potassium Myronate = $C_{10}H_{18}KNS_2O_{10}$ = 415.424 with Myrosin, which is similar to the ferment Emulsin in Bitter Almonds. This glucoside splits up under the influence of water with evolution of Allyl-iso-sulphocyanate, C_3H_5NCS = 99.13, the principal constituent of the Essential Oil. P.G. requires Black Mustard Seeds to yield at least 0.7% of this.

White Mustard Seeds contain the glucoside Sinalbin $C_{20}H_{44}N_2S_2O_{16}$ = 752.642.

This also splits up with water and Myrosin with evolution of an oil, White Mustard Oil (acrinyl isothiocyanate) $C_6H_4OH \cdot CH_2 \cdot NCS$ (1 : 4) = 165.166 which, however, cannot be distilled with water. As the black seeds contain an excess of their glucoside and the white an excess of the ferment, the combination of the two produces the strongest effect. Some work by Prof. Greenish, however, (P.J. i./12,203), shows that in all the samples of black mustard-seed examined—both old and new—there was sufficient myrosin to decompose all the sinigrin present, and that properly preserved black mustard-seeds retain their myrosin unimpaired for many years. Two samples examined contain sufficient myrosin to decompose a much larger quantity of sinigrin than the seeds themselves contained.

The practice of adding Farina (wheat starch)—some 12 to 14%, to Mustard—producing the mixed article '**Condiment Mustard**' is legalised by the 1875 Food and Drugs Act. A Borough Council and certain manufacturers' correspondence.—P.J. i./17,470.

The percentage of oil is 0.3 to 0.86. Dutch Seeds are best. Examination, Detection of Myrosin and Sinigrin.—P.J. ii./04,475; i./05,719.

Oleum Sinapis Volatile. The following tests are given *Off.*—Sp. Gr., 1.014 to 1.025. Distills between 148° and 156° C. Should contain not less than 92 per cent. of allyl-iso-thiocyanate, determined by a process provided.

SODIUM.

An electrified gas from *Sodium*, according to C.E.S: Philips, exists which discharges a negatively charged electroscope: not so much when + charged. This is *not* due to rapid oxidation of the surface of the Sodium Na., May 28, '08, 79; June 11, '08, 127.

Electrolysed Brine used for hospital ship disinfection by means of a specially constructed cell (Mather & Platt) under Dakin's direction resulted in abolishing secondary infections among patients and ship's staffs and crews.—L. ii./16,949.

Bismuth Cæsium-Potassium Nitrite.

Dissolve 50 Gm. of Potassium Nitrite in 100 Cc. of Water, neutralise with Nitric Acid and add 10 Gm. of powdered Bismuth Nitrate, then add sufficiency of 10% Solution of Cæsium Nitrate to precipitate the Sodium present in the Potassium Nitrate, filter and add Cæsium Nitrate to a total of 2.5 Gm.

A reagent by means of which small amounts of Sodium may be detected and estimated in presence of large quantities of potassium, the corresponding Sodium Salt 5 Bi (NO₂)₃.9Cs.NO₂.6NaNO₂ being almost insoluble.—Nature Feb. 24, 1900, p. 498.

A slightly varied formula for the Sodium Salt is stated—also that 1 of Sodium Nitrite in 3000 of Potassium Nitrite can be detected by the reaction.—P.J. i./13,673. The amounts of the ingredients in the proportions stated in the "Nature" reference show an excess of Potassium Nitrite and Bismuth Nitrate over the amounts required theoretically,—these would be 51 Potassium Nitrite, 48 (Crystalline) Bismuth Nitrate and 39 Cæsium Nitrate.

Sodium, Ammonium and Potassium Persulphates are strong bleaching agents, the latter K₂S₂O₈=270.32, known as **Anthion**, and the Ammonium Salt are used in Photography to reduce dense negatives—they oxidise and then dissolve part of the silver.

On adding Barium Chloride to a solution of Potassium Persulphate there is no precipitation, but on warming, Barium Sulphate is thrown down.

The Ammonium Salt (NH₄)₂S₂O₈=228.204 is prepared by electrolysis of a solution of ammonium sulphate containing sulphuric acid. In presence of water it yields ozonized oxygen. **To sterilise sponges.** It has been used as a hand disinfectant. It bleaches.

For details of the therapeutic use of the Sodium Salt, see *Vol. I.*

SEPARATION OF CHROMIUM, IRON and ALUMINIUM by means of AMMONIUM PERSULPHATE.

The precipitated hydroxides are mixed with water in a porcelain capsule, a small quantity of ammonium persulphate is added and the dish warmed until the precipitate is dissolved. Thus the chromic hydroxide is converted into a compound of chromic anhydride. On the addition of an alkali the iron is precipitated as a ferric hydroxide and the aluminium and chromium can be detected in the solution in the ordinary way. Re-solution of the ferric hydroxide in acid and reprecipitation with alkali effects a complete separation of the iron.—C.D. i./11,133.

Sodii Hyposulphis.

Hampshire and Pratt find that semi and decinormal solutions decomposed slightly but even after 8 months these dilute solutions are reliable for volumetric work. The deposit of Sulphur may be due to oxidation or action of CO₂ or to a simple decomposition by light.—P.J. ii./13,142.

To preserve the volumetric solutions a few drops of carbon disulphide added are useful.

Spiritus Ætheris Nitrosi, see **Ætheris Nitrosi Spiritus**.

STROPHANTHUS.

Strophanthus Tincture *Off.* is prepared by first removing the fat with Ether. U.S. employs Petroleum Benzin. The menstruum in the first case is 70 % Alcohol, in the second 95 %.

Experiments on removing fat from, by cooling to 14° C., and by other methods. Cooling satisfactory.—P.J. ii./99,469.

It has been stated that the fat in Strophanthus Tincture gives it an emetic action.—Experiments on animals in America show this to be unfounded,—the fat being void of action. On the other hand, a dose of fat-free tincture injected *subcutaneously* produced prompt emesis.

U.S. IX. Biological Assay. The method is similar to that used in the case of digitalis (q.v.) The one hour frog method is adopted. The dose of the preparation is ascertained which will bring the heart of the frog to systolic standstill in one hour's time. The standard adopted is 0.000006 Gm. of Strophanthus Seed in the form of Tincture or 0.00006 Cc. of the Tincture to effect this per Gm. of body weight of frog.

STROPHANTHUS SEEDS. ASSAY BY CHEMICAL METHODS.

The powdered seeds (20 Gm.) are freed from oil by percolation with Petroleum Ether or Ethyl Ether,—they are then exhausted with Alcohol 70%. This tincture is evaporated to a soft extract at a low temperature, dissolved in 100 Cc. of Water, filtered in a separator, 3.2 Cc. of Sulphuric Acid (25%) added, then shaken out thrice with 20 Cc. Ether. The aqueous acid solution is warmed in a water bath for one hour at not exceeding 75° C. This decomposes the Strophanthin present into Strophanthidin and Strophanthobiose Methyl Ether. It is then cooled and shaken out in a separator with 10 Cc. of Chloroform,—Strophanthidin being soluble in this reagent. This is evaporated to a low bulk in a tared dish, allowed to crystallise out and dried at below 65° C. The result divided by the factor 0.365 gives amount of Strophanthin present. Various samples of the seed by this method gave 3.1 to 4.57% Strophanthin. A standard of 0.1% w/v Strophanthin is suggested. A chemical method is probably as useful as the physiological test.—J. Haycock, P.J. i./11,553; B.C.D. i./11,94

Fromme's 1910 Assay Method.—In a critical comparison by J. B. Lampart and A. Muller, of various methods of assaying **Strophanthus Seeds** and Tincture, including Fraser's, Fromme's 1897, 1900, 1905 and 1910, Thom's, Mann's, Dohme's, Haycock's, Dowdard's and Barclay's. Fromme's 1910 method was found to give best results and to agree well with physiological results. It is as follows:—7 Gm. of seeds finely powdered are boiled one hour with 70 Gm. of Absolute Alcohol in a tared Erlenmeyer flask (200 Cc.) under a reflux condenser. It is then cooled and made up to original weight with Absolute Alcohol. The liquid is filtered and 50.5 Cc. (=5 Gm. seeds) of this evaporated on a water-bath, the residue being extracted with Petroleum Ether to remove fat. The undissolved portion on the filter is washed back into the dish with 5 to 8 Gm. of boiling water. The whole is heated to boiling and 5 drops of Lead Acetate Solution and 0.2 Gm. of Kieselguhr are added, the whole mixed and transferred to a 5 Cm. filter and filtered into a 100 Cc. Erlenmeyer flask, washing through with boiling water in small quantities until the washings are no longer bitter.

Five drops of Hydrochloric Acid are added to the filtrate which is then boiled gently for two hours. It is then made up to 20 Cc., cooled and extracted with two quantities of 10 Cc. of Chloroform which are filtered into a 100 Cc. flask. The aqueous portion is boiled again for half an hour, extracted with Chloroform as before and if the aqueous portion is still bitter the process must be repeated. The mixed Chloroformic Extract is distilled and the residue dried in the desiccator to constant weight. This consists of Strophanthidin, and when multiplied by 2.187 gives the weight of Strophanthin represented.

For the **Tincture** 51 Gm. is evaporated, the residue is dissolved in 20 Gm. of hot water, 20 drops of Lead Acetate Solution and 0.2 Gm. of Kieselguhr are added and the process continued as above.—W. Kroseberg, P.J. i./11,590.

The **Oil** in Strophanthus Seed is inactive. The poisonous property of the seeds is due to water-soluble glucoside or glucosides. No active principle other than the water-soluble body was found. Methyl Alcohol is also a good

solvent. Chloroform is a poor solvent. The best method to prepare a tincture on the large scale is to moisten the defatted seeds with 65% Alcohol, then extract in a long narrow percolator until the seeds are free from bitterness, then assay both chemically and physiologically and dilute with 65% Alcohol to an official strength.—Karam Samaan, B.P. Conf., 1919.

Recommendation to substitute a preparation of **Strophanthin** in place of tincture of the seeds—unmixed Kombé seeds being now unobtainable in sufficient quantity. Suggestion that the seeds should be required to contain 6 to 8% Strophanthin and the Tincture 0.6%. Chemical assay in preference.—C.T. Bennett, B.P. Conf., 1920.

The geographical range of *S. Kombe* is limited. It might be well to order the use of *S. Hispidus* instead—it is more easily obtained and is the only other species giving the green colour with Sulphuric Acid.—E.M. Holmes, P.J. i./19,33.

TEREBINTHINA CANADENSIS (Off.)

The balsam obtained from *Abies balsamea* (Coniferæ), known as Canada Balsam. Is a constituent of Collodium Flexile (Off.). It has a refractive index approximating that of microscopic glass, and 'sets' in a non-crystalline transparent condition, hence is used as a mounting medium. In preparing for use it has to be gently heated in an open dish for a week or more until a small quantity removed becomes brittle when placed on a cold slab. Canada Balsam 1 part by weight in Xylol, in turpentine, in benzol, and in chloroform, each 1 by measure, are prepared for microscopic use. The first mentioned is chiefly employed and is frequently designated '**Xylol-Balsam.**'

Canada Balsam contains 18 to 20% of oil. For adulterants and table of composition of this and other coniferous resins, *vide* Allen, 1911, Vol. IV., p. 79

THALLIUM.

Tl=204.

This element, resembling lead on the one hand and Potassium on the other, was discovered by Crookes by spectral analysis in residues of sulphuric acid manufacture.

Thallium Acetate $Tl\ C_2H_3O_2 = 263.034$. Dose.— $1\frac{1}{2}$ to 3 grains (0.1 to 0.2 Gm.) was tried in syphilis, but is not equal to mercurials; if given an hour before the commencement of a sweat, was found of value in the night sweats of phthisis. Loss of hair and arrest of perspiration accompany its use.

Poisoning by Thallium Acetate.—A workman drank a small quantity—less than 1 Gm. in solution in a Vichy bottle. Caused vomiting, acute sense of internal chill, cyanosis, lowered temperature, pain in the kidneys and reduction in urine voided. Abundant drinks were ordered, and baths. Symptoms disappeared in a few days. Loss of hair and arrest of perspiration were *not* seen.—L. i./11,1461.

THEOBROMA.

Theobroma Oil, Detection of Adulteration.—An authentic specimen has following characters:—S.V. 196. I.V. 31, Volatile Fatty Acids 0.7%, Acid Value 0.6, M.Pt. 27° C. Butyrefractometer reading at 40° C. 46.5 Soluble in Ether 1 in 2, clear at 18° C. Coconut fat, Wax, Spermaceti, Margarine and Paraffin must be searched for.—Y.B.P., 1913,97.

'Cocoa.'—The ground nibs of Theobroma Cacao from which most of the fat has been removed.

At the second International Food Congress (1909) it was declared that the use of alkali should be tolerated—the whole question being submitted to an international commission. The use of alkali enables the production of a "cheap" cocoa.

The examination of a number of Cocoas in the market showed moisture to range from 3 to 8%, Nitrogenous Matter ($N \times 6.3$) 19% to 20%, Fat 26 to 31%, Mineral Matter 3.9 to 8.8%, Theobromine 1.7 to 2.0%.—L. i./05,316.

The generality of the Cocoas made by Manufacturers of repute and sold on the English market do not contain alkali. There has been some misconception on the part of some people in interpreting results of analysis. Clearly

the natural salts of Cocoa yield alkaline Carbonate on ignition. That sold by E. Sandow yields alkalinity of ash equivalent to 2.82% K_2O which is as high as most of the cocoas examined by the "*Lancet*." In some cases alkali is used in the *preparation* of Cocoa, but false alarms should not be raised. The presence of true alkali—caustic alkalis—in cocoa is inconceivable.—L. i./13 258.

A certain cocoa is guaranteed to contain no starch when in fact it is present —E. J. Parry, P.M.C.E., C.D. i./13,562.

Theobromine may conveniently be estimated by converting it into its **Periodide** $C_7H_8O_2N_4.HI.I_4$ and titrating the excess of Iodine. The process will work in presence of Sodium Acetate or Salicylate.—Abst. Ann. Rep. Chem. Soc. 1919 (Vol. XV.), p. 130.

New compounds of Caffeine and Theobromine (**Abelin**): Calcium Caffeine-o-acetoxy-benzoate and the analogous theophylline body.—J.C.S.A. i. 20,327.

Essential Oil of Cocoa 12 Gm. obtained from 1000 kilos of beans by distilling at 120° C. with superheated steam. The Oil, resembling Coriander somewhat, has an intense odour, being perceptible in 1 in 50,000,000 of Syrup —C.D. ii./12,752.

SUPPLEMENT.

Abietic Acid derivatives and decomposition products.—J.C.S.A. i /20,232.

Acacia Gum Glucose Injections.—Intravenously influences urine excretion and blood volume in rabbits. Gum Acacia is capable of maintaining the blood volume in spite of marked Glucose diuresis. Glucose injections without Gum Acacia produce a diminution of the blood volume.—P. M. Mattill, Katherine Mayer & L. W. Sauer, Jl. Pharm. & Exp. Therap., Dec. 1920.

Acetic Anhydride preparation. British Patent 137701. By interaction of Anhydrous Sodium Acetate and Carboxyl Chloride, thus $2CH_3.COONa + COCl_2 = (CH_3.CO)_2O + CO_2 + NaCl$ —J.C.S.A. i.20,287.

Acridine Compounds—3 : 6 **Diamino - Acridine** preparation.—Poulenc Freres & R. Meyer, Pat. 137,214 Abst. J.C.S.A. i.20,252.

Adsorption of Phosphate, Citrate, Tartrate, Oxalate, Sulphate, Iodate and Dichromate ions by definite quantities of precipitated **Ferric Oxide** from a Ferric Oxide sol.—H. B. Weiser, J.C.S.A. ii.20,228.

Allocain S.—Ethyl-Mydriatine Hydrochloride. A new local anaesthetic stronger than Novocain and weaker than Cocaine. On account of the slight irritation caused by its acid solutions and of precipitation by tissue fluids its use is limited. Adrenalin, Ephedrine, Mydriatin are allied chemically.—S. Kubota, Jl. Pharm. & Exp. Therap., Feb. 1919.

Aloin, Oxidation of, and of other constituents of aloes with alkali persulphate also by Caro's Acid and Sodium Peroxide.—E. Seel J.C.S.A. i,20,67 *et seq.*

Aloes, Cascara, Rhubarb, and other **Emodin** containing drugs—process of separation and identification employed in U.S.A. for examining nostrums.—W. S. Hubbard, Jl. Ind. Eng. Chem. IX., p. 518. P.J. i./17,469.

Amyl Nitrite which had become decomposed, Ammonium Tetroxalate crystals found in.—J.C.S.A. i./20,288.

Areca Nut Alkaloids.—These are related. Arecaidine, Arecoline (Arecaidine Methyl Ester), Guvacine, Arecaine (N-methylguvacine) and Guvacoline, (Guvacine Methyl Ester). Arecaine can be produced by the action of Formaldehyde and Formic Acid on Guvacine. Arecoline has been made by esterifying Arecaidine with Methyl Alcohol. Guvacoline has been converted into Guvacine and vice versa by esterification or hydrolysis.—Hess & Leibbrandt, Ber. 1918, Abst. Ann. Rep. Chem. Soc., 1919 (Vol. XV.), p. 107; see also J.C.S.A., Feb., 1919, p. 93.

Arsenobenzol. Experimental investigation into the cause of death from.—Jackson & Smith, Jl. Pharm. & Exp. Therap., Nov. 1918,221.

Arsenobenzol-Silver. *Syn.* **Silver Salvarsan.** Contains Silver Oxide in complex form. It does not contain Colloidal Silver.—J.C.S.A. i.20,401.

Aromatic Arsenic Compounds for chemotherapeutic research. A general review.—Jacobs & Heidelberger, J.C.S.A. i, 20,107 *et seq.*

Artemisia brevifolia (Wallich) found to contain about 1% Santonin. It occurs from Kashmir to Kumaon at 7,000 to 9,000 ft. altitude.—Prof. Greenish, P.J. i./21,2.

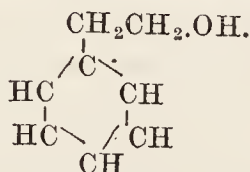
Belladonna leaf is valued as to alkaloid and ash content, thus in Nov. 1914, Belladonna Leaf from any source reached 100s. Ordinarily the leaf from Germany fluctuated between 38s. and 60s. per cwt. for leaf containing from 0.175 to 0.54% alkaloid and of ash from 22.9 to 13.2% and according more or less to colour.—E. M. Holmes, P.J. i./15,5.

'**Indian**' **Belladonna** possibly a **Scopola** species, e.g. *S. lurida*. According to E. J. Waring a tincture made with the leaves of this plant 1 in 8 of alcohol administered to patients produced extreme dilatation of the pupils. The largest dose was 20 drops during 24 hours—in two cases causing blindness. Great caution necessary.—E. M. Holmes, P.J. i./17,351.

Benzyl and **Benzylidene Chloride** and homologues and substitution compounds, Patent 134,250, see J.C.S.A. i.20,21.

Benzylcarbinol, *Syn.* *B*-phenyl-ethylol. '**Rose Oil**' or '**Orange Oil**.'

A local anæsthetic



thought to be superior to Benzyl Alcohol. Toxicity about the same as that of the latter. It is sufficiently soluble for therapeutic use.—A. M. Hjort & J. T. Eagan, Jl. Pharm. & Exp. Therap., Nov., 1919.

Bismuth Anhydro-methylene Citrate, Diethylmalonate, Mandelate, Vanillate and Cinnamate made with help of Bismuth-Mannitol solution obtained by grinding together Bismuth Nitrate Cryst. (1 mol.) and Mannitol (1 mol.) and treating the mass with water.—J.C.S.A. i.20,9.

Organo derivatives of **Bismuth**. Preparation of derivatives of Quinquevalent Bismuth.—J.C.S., June, 20, 762.

Camphor Compounds : **Homocamphor**, a substance differing from Camphor in the inclusion of an additional CH_2 group in the ketone ring.—A. Lapworth & F. A. Royle.—J.C.S., June, 20, 743.

Calomel and **Antipyrin** are incompatible. Reaction does not occur in presence of water or acid media such as gastric juice but in the presence of alkali changes occur which cause marked toxicity. Chemical compounds discussed.—J.C.S.A. i.20,94.

Caoutchouc, Vulcanisation of, with Benzoyl Peroxide and Lead Oxide in presence of Di- or Trinitrobenzene.—J.C.S.A. i.20,244; see also *ibid* 245.

Carminic Acid is a hydroxyanthrapurpurin.—J.C.S.A. i.20, 442.

Chloramines are powerful irritants. A thorough experimental study of effects of Chloramine-T on animals.—B. Fanus & M. I. Smith, Jl. Pharm. & Exp. Therap., Nov., 1919.

Choline Borate, Salicylate, Iodobenzoate, etc. solutions, relatively non-poisonous—subject of patent 8031/1914, see J.C.S.A. i.20,18.

Cocaine.—The physiological activity is connected with the presence of the acylated hydroxyl group in the γ position with regard to the Nitrogen atom in the ring. Synthetic proof.—Ann. Rep. Chem. Soc., 1919 (Vol. XV.), p. 110.

Croton Gubouga.—Has a reputation in the Eastern Transvaal as a remedy for malaria. The seeds and bark have been used. Prof. Greenish, P.J. ii./18,p. 289, found an acrid constituent. An acid 4-Hydroxyhygric acid isolated.—J.A. Goodson & H. W. B. Clewer, J.C.S., Aug., 19, p. 923.

Digitalis Bodies, Further work on.—Digitogenic Acid, Digitaligenin, Digitoxigenin.—H. Killian, J.C.S.A. i.20, 320.

Emetine and **Iso-emetine** are apparently stereo-isomerides, although the attempt to convert one into the other has not been successful. Iso-emetine is the methyl ester of isocephaeline. F. L. Pyman, Trans. Chem. Soc., 1918, 113, 222

Ephedrine: constitution is $\text{OH}.\text{CHPh}.\text{CHMe}.\text{NHMe}$.—J.C.S.A. i.20, 393.

Eucalyptol.—Arsenic Acid method estimation. It forms an addition compound sufficiently stable for the purpose and the results are accurate within 2%. The Phosphoric, Hydrobromic Acid and Resorcinol methods criticised.—J. L. Turner & R. C. Holmes, P.J. i./15,60.

Glass for Technical Purposes. The **British Science Guild** issued a Report regarding manufacture of Optical instruments. The **Glass Research Committee** of the Institute of Chemistry provides formulas for laboratory

glassware. Valuable formulæ for soft glass, resistant glass, combustion tubing glass (= Jena), miners' lamp glass, soft soda glass for tubing and X-ray bulbs, etc., are provided.—C.D., Apl. 24, 15, p. 534.

Grignard Reaction, Mechanism of.—J.C.S.A. i./20,30.

Guaiacol and Veratrole, Arsinic Acids derivatives from.—R. G. Fargher J.C.S., July, 20,865.

Henna, the constitution of Lawsone.—J.C.S.A. i./20,626.

Hexamine.—If commercial Ammonium Carbonate is treated with 40% Formic Aldehyde solution it readily dissolves even without application of heat, with brisk evolution of Carbon Dioxide and formation of Hexamine. Evaporate to dryness on water bath under reduced pressure and sublime or recrystallise from absolute alcohol. The Ammonium Carbonate should be about 10% in excess of theory.—J.C.S.A. i./20,292. Other Ammonium salts react similarly. *ibid.* 373.

Holarrhena Congolensis. The leaves were found to have local anaesthetic effect.

Holarrhenine $C_{24}H_{38}ON_2$ an alkaloid was isolated.

In further work the powdered bark of the tree was percolated with diluted Hydrochloric Acid, the liquor made alkaline with Ammonia and extracted with Chloroform. The Chloroform extractive was purified by means of Petroleum Ether.—F. L. Pyman, J.C.S., Feb., 19,163.

Hydrofluoric Acid.—Bad burns may be produced in a delayed manner. Swelling of thumb and finger consequent on handling a cracked gutta-percha bottle of the acid. The skin became distended to bursting point with intense pain. Blisters were punctured. 1% Phenol compresses and later Normal Saline. Sodium Bicarbonate bath or preferably Ammonium Carbonate suggested as best treatment.—F.C.C. Robb, P.J. i./20,560.

Hyoscyamus Niger.—Sum Jensen found in carefully selected samples that the root is richest in total alkaloids and that the annual plant is, if anything a trifle richer than the biennial leaves either of the first or second year: thus Biennial Root 0.16%; Leaves biennial first year 0.059 to 0.069%; Leaves and tops second year 0.065 to 0.068%; Leaves and tops, annual, 0.064 to 0.07%.—P.J. i./15,98.

Iceland Moss used in making Colloidal Copper.—J.C.S.A. ii.20,22.

Magnesium Sulphate.—Scalds and burns well treated by a concentrated (25% and over) solution.—S. J. Meltzer, Jl. Pharm. & Exp. Therap., Nov., 1918

Nickel, Dimethyl-Glyoxime.—Delicacy of the test for Nickel.

Thorpe states 0.1 mgr. of Nickel can be detected in presence of 5,000 times as much cobalt, but gives no details as to the strength of solution. Our recent experiments using a 1% alkaline solution of Dimethyl-Glyoxime showed that:—

1 in 1,000 solution of Nickel sulphate gave copious pink precipitate.

1 in 10 000 " " " " " " slight pink precipitate.

1 in 100,000 " " " " " " pink colour precipitating after a time.

1 in 200,000 (= 1 in 1,000,000 Nickel) was the limit.

Further, Manganese alone gave no colour but in solution with an equal amount of nickel reduced the delicacy to about 1 in 2,000 of nickel sulphate. Cobalt chloride alone gave a brown colour but no precipitate. It also reduced the limit of delicacy to about 1 in 2,000 using equal parts cobalt chloride and nickel sulphate. See also A. C. Chapman, C.D. i./17,286.

Nitrogen Fixation.—For some years prior to 1914 Germany had been making Cyanamide on a limited scale and not long before the outbreak of war the Haber process for producing Ammonia by direct union of Hydrogen and Nitrogen had reached the stage at which its success as an industrial process was assured. In addition Germany possessed Ostwald's Process for converting Ammonia by oxidation into Nitric Acid. Our supplies of Ammonia on the other hand were restricted by the output of our gas works and coke ovens and we were entirely dependent for Nitric Acid on the import of Sodium Nitrate. The synthetic production by Germany of Nitric Acid during the war was a remarkable achievement. We must have the means to produce Ammonia and Nitric Acid to any amount within our own shores. Nitrogen Fixation constitutes an essential key industry.—Sir J. Dobbie, Pres. Add. J.C.S., Apl., 20, 430.

The first person in this country to direct attention prominently to the development of the Fixed Nitrogen industries abroad was Prof. Crossley. In a lecture before the Pharmaceutical Society in 1910 he gave an account of the produc-

tion of Nitrogen compounds at Odda, in Norway, and pointed out its importance in agriculture and as a means of supplying the necessary Nitric Acid for manufacture of explosives.—Sir J. Dobbie, *ibid.* See also A. W. Crossley P.J. i./10,329.

Pelletierine is β -2-piperidyl propaldehyde or in other words the aldehyde of Coniine. Though a secondary base it does not react with Nitrous Acid. The alkaloids of Pomegranate root seem to be entirely racemic though originally believed to be optically active.—Hess & Eichel, Ber., 1917.

Pimento Leaf Oil contains 89% Eugenol. The start of an important industry in Jamaica. By the fermentation of the leaves the oil spontaneously changes into iso-eugenol, the half-way product in the preparation of Vanillin. The wild Pimento trees of Jamaica could therefore compete with the growers of cloves in Africa or Cinnamon in Ceylon from the Vanillin producing point of view.—C.D., 20,1253.

Experimental nephropathy produced by tetrahydroxymercuri-phenolsulphone-phthalein.—Burns & co-workers, J.C.S.A. i.20,610.

Saccharin, Influence of, on the catalases of the blood.—Some of the recent work on Saccharin has had a tendency to ascribe to this compound an action beneficial to the processes of oxidation in the blood, particularly in diabetes. F. C. Becht finds there is no evidence that it produces any change in the catalytic power either in the positive or the negative direction *per os*. 4 Gm. per kilo is a powerful gastro-intestinal irritant. Given intravenously it produces a marked decrease in the catalase content of the blood. There is no difference in the case of an animal with pancreatic diabetes from the normal.—Jl. Pharm. & Exp. Therap., Oct. 1920.

Seaweed, New sugar isolated from.—J.C.S.Ai./1909, p. 387.

Selenium Aromatic Compounds.—Attempts to form the Selenium analogue of Arsanilic Acid, namely p-amino-phenylselenic Acid $\text{NH}_2\text{C}_6\text{H}_4\text{SeO}_3\text{H}$. (Aniline Sulphate and Arsenate readily yield Sulphanilic Acid and Arsanilic Acid at an elevated temperature but no similar compound can be obtained from Aniline Selenate). M-aminophenylselenic acid and an acetyl and other compounds are, however, described.—F. L. Pymian, J. C.S., 1919,166.

Senecio disease.—Cirrhosis caused by seed of *S. ilicifolius*, etc., in grain in S. Africa.—L. ii./20,848. See also A. R. Cushny, *ibid.* 1089.

Simaruba. Decoctum, Syn. Mistura Simarubæ et Granati.—The formula has been modified by the Ministry of Pensions replacing Cinnamon 15 per 1,000 for the Acacia. Found satisfactory in dysentery.—C.D., 20,1320.

Sodium Salicylate. Solutions with Sodium Bicarbonate become dark due to oxidation. A small quantity of Sodium Sulphite, bisulphite or hyposulphite prevents discoloration.—H. G. Greenish & A. E. Beesley, P.J. i./15,210.

Yeast and a fungus which grows naturally in Salicylate solutions destroy the Salicylate. It is also destroyed to the extent of 20% on ingestion.—P.J. Hanzlik & N. C. Wetzel, Jl. Pharm. & Exp. Therap.

Thromboplastin: Anaphylaxis from.—Jl. Ph. Exp. Ther., Nov., 1919.

Uzara.—A preparation for dysentery. An account of this was given in the Sixteenth Edition, p. 854. The nature of the particular active native drug employed, from the African Lake District has been the subject of discussion—supposed to have been an asclepiad: now thought to be *Dicoma Anomala* (*Compositæ*).—Prof. Greenish, P.J.ii./20, 474, and E. M. Holmes, *ibid.* 507.

Vitex Peduncularis.—An Indian forest plant. In malaria and blackwater fever, infusion of leaves 1 oz. in 40 ozs., this forming a dose spread over 24 hours. Frequently made stronger, e.g. 1 in 10. Successful.—J. C. S. Vaughan, B.M.J. i./21,186.

Xanthium Macrocarpum. *N.O. Compositæ*—Have been offered as Spanish Stramonium—Evans Anal. Notes.

Yohimbine Comps. (Arsenate, methylarsinate, etc.).—J.C.S.A.i./1919,549.

ANIMAL ORGANOTHERAPY.

PITUITARY GLAND.

Histamine.—Presence of, in the hypophysis cerebri. It plays an important role as stimulant for the gastric and intestinal musculature and as a dilator of capillaries during digestion. We daily

consume no inconsiderable amount of it.—J. J. Abel & S. Kubota, *Jl. Pharm. & Exp. Therap.*, June, 1919, and Nov., 1919.

D. Cow disputes the conclusion of Abel & Kubota that histamine is the plain muscle stimulating and depressor constituent of the posterior lobe of the pituitary gland, and states that the physiological and chemical evidence of the identity of the two principles do not coincide at every point.

He finds that the uterus of the mouse affords an example of a tract of plain muscle which reacts in one way to histamine and in a diametrically opposed way to pituitary extracts, and his results do not appear to bear out the hypothesis of the authorities mentioned.—*Jl. Pharmacol. & Exp. Therap.*, Nov. '19, p. 273. See also Dudley *ibid*, 295.

For further notes on Histamine, see Ergot, Vol. I and Vol. II.

SUPRARENAL CAPSULES.

Suprarenal Gland U.S.—An assay process is provided by comparing the rise in blood pressure produced in a dog by an injection of an aqueous preparation of the gland with that produced by a dilute solution of Lævo-methylamine-ethanol-catechol.

EPINEPHRINE CONTENT, U.S. IX. TEST. (Requirement not less than 0.4 nor more than 0.6%.) Add 0.005 Gm. finely powdered Manganese Dioxide and 10 Cc. of water to 0.01 Gm. dry Suprarenal Gland. Thoroughly shake during 1 hour and filter. Compare the colour of the liquid in a test-tube with the colours produced by mixing a 2% solution of Cobaltous Chloride containing 1% concentrated Hydrochloric Acid and a dilute Gold Chloride solution (below).
1.85 Cc. Cobalt Solution + 0.95 Cc. of Dilute Gold Solution + 7.2 Cc. Distilled Water

= 0.2% Epinephrine.

2.95 Cc. Cobalt = 1.25 Cc. Gold + 5.8 Cc. Distilled Water

= 0.4% Epinephrine.

4.05 Cc. Cobalt + 1.35 Cc. Gold + 4.6 Cc. Distilled Water

= 0.6% Epinephrine.

5.15 Cc. Cobalt + 1.55 Cc. Gold + 3.3 Cc. Distilled Water

= 0.8% Epinephrine.

Dilute Gold Solution.—First make a *strong* Gold Chloride solution by dissolving 1 Gm. Gold Chloride ($\text{AuCl}_3\text{HCl} + 4 \text{H}_2\text{O}$) in 30 Cc. water.

Take 10 Cc. of this strong solution in a *weighed* porcelain crucible, add about 1 Cc. of 4% Ammonium Oxalate Solution and evaporate to dryness. Cautiously ignite until no further loss, and weigh. Calculate the exact amount of metallic gold in the solution assayed and dilute the remainder with water so that 100 Cc. contain 0.1 Gm. metal gold.

We have had some experience with this test and find it adequate. A sample of British Dry Suprarenal Gland showed 0.8% Epinephrine.—W. H. M., Aug. 1920.

A sample of American manufacture showed 0.4%.—W. H. M., Sept. 6, 1920.

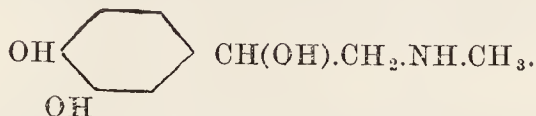
Another Colorimetric (Iodine) method was given in our last Edn., p. 131.

A further method employing Platinic Chloride and Cobalt Chloride is given by J. Stanley White.—P.J. i./17,159.

Adrenalin.

TEST OF IDENTITY.—A peculiar odour like phosphoretted hydrogen is developed on treating a small quantity of the salt or solution with a few drops of sodium hydrate solution.—P.J. i./07,718,774,797. See also Organic Analysis Chart.

Regarding the **Adrenalin** and **Epinephrin** controversy, P. May summarises as follows:—The active principle of the suprarenal gland was first obtained in an impure condition by Abel and Crawford in 1897, and in a more pure condition as the Benzoyl derivative in 1899. They called it Epinephrine, and it was also isolated by v. Fürth who called it Suprarenine. *Takamine* (1901) *first obtained it crystalline and gave it the name of Adrenalin*. Shortly afterwards it was isolated by Aldrich by a somewhat different method and given the formula $C_9H_{13}O_3N$ which is now generally adopted. After other suggestions Jowett confirmed the formula of Aldrich and Friedman and aided in clearing up the constitutional arrangement as



It would appear that the pancreas has the power of inhibiting the sensitiveness to Adrenalin in certain organs supplied by the sympathetic nerve—*i.e.* normally Adrenalin does not dilate the pupil, but this does occur in certain cases, *e.g.*, extirpation of the pancreas, pancreatic insufficiency, in diabetes, and in some cases of Basedow's disease. This susceptibility is probably due to hyperthyroidism.—J.C.S.A. ii./08,712.

There is some doubt as to the **Amino-Acid** from which Adrenalin is built up, but the chemical constitution of **Tyrosin** and Adrenalin is sufficiently close to be very suggestive. It is known that the action of bacteria on Tyrosin results in its splitting up and this fact may explain some of the symptoms of intestinal stasis. The abnormal presence of bacteria in the small intestine results in a decomposition of the Tyrosin which is, therefore, absorbed in deficient amount and consequently the suprarenal gland being supplied with a deficiency of the precursor of Adrenalin is able to manufacture only a deficient amount and a deficiency of Adrenalin proportionate to the amount of intestinal infection, with the corresponding symptoms, results.—From a Paper on Intestinal Stasis.—L. ii./12,1783.

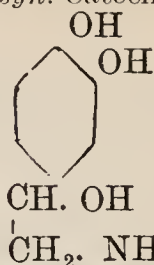
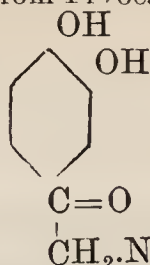
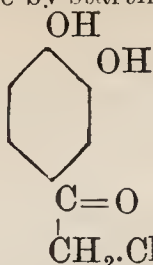
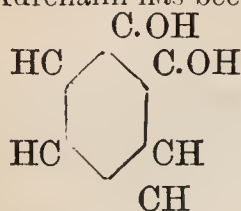
Mydriatic Power of Adrenalin. The eye of the frog is so sensitive to Adrenalin that it may be used to detect minimal amounts of the substance. The mydriasis is observed in all conditions associated with increased excitability of the sympathetic system. May be used (instillation of the 1 in 1,000 solution) as diagnostic—though uncertain and inconstant. Functional disturbance of the pancreas, overaction of the thyroid, diabetes mellitus and perhaps exophthalmic goitre are associated with increased sensibility to Adrenalin. In all these states probably the adrenal content of the blood is increased.—B.M.J. i./13,572.

Loewi's Test for Pancreatic Inefficiency.—2 or 3 drops of 1 in 1,000 Adrenalin solution dropped into the conjunctival sac and repeated after an interval of 5 minutes. In the majority of cases no dilatation of the pupil occurs, but in a few cases there is conspicuous dilatation in $\frac{1}{2}$ or 1 hour. Loewi in Vienna found mydriasis only in one out of three cases of exophthalmic goitre and in 10 of 18 diabetics. It is of undoubted value in the diagnosis of pancreatic lesions provided always that its ways have been studied and that limitations are fully recognised.—Sir A. E. Garrod, L. i./20,751.

Adrenine (Epinephrine) is present in the suprarenal glands of the whale, and can be separated from them, preserved in Chloroform after 6 to 9 months. Highest yield was 0.2% of the moist material, or about 1.2 Gm. from each gland.—Y. B. P., 1913,2.

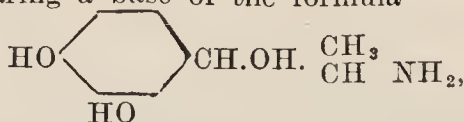
Suprarenin (Synthetic). (See also vol. I., p. 926).

A body with chemical and physiological properties very similar to those of Adrenalin has been made by starting from Pyrocatechin (*syn.* Catechol):—



converting this into Chlor-acetyl-pyrocatechin; thence with Methylamine into the Ketone (*syn.* Adrenalone), Stolz. Ber. 39 (1904) 4,149; D.R.P. 152,814; English Patent (1903) 25,480; finally reducing to the body Dihydroxy-phenylmethylaminomethyl-Carbinol of the fourth formula above strongly resembling Adrenalin (by electrolytic reduction or by action of Aluminium Amalgam on the sparingly soluble sulphate of the Ketone.—D.R.P. 157,300). The Ketone is not much more powerful than the Chlor-acetyl body. They are both physiologically very active, but not nearly so powerful as the ultimate body.—Dakin, JI. Physiol., Vol. XXXII. lii./05,341.

A method of preparing a base of the formula



having similar properties to the active principle of suprarenal glands, has been patented. English Patent (1912), No. 8957. The process is to reduce α -aminopropionylpyrocatechin with hydrogen in the presence of colloidal palladium and to separate the dextro- and lævo- compounds by means of dextro- and lævo- tartaric acids. The lævo- base has M.Pt. 218° C.; the dextro-base melts at 217° C.

Hydroxy- and Dihydroxy-phenylserines and the parent substance of Adrenalin.—J.C.S.A.i.20,56.

Patented Synthesis 118,298, by N. Nagai, see J.C.S.A.i.20,43.

Intravenous injections of small volumes of Concentrated Salt Solution (Sodium Carbonate) cause a temporary increase in rate of liberation of Epinephrine from the adrenals.

Depressant action of Nicotine on Epinephrine output.—Stewart & Rogoff, JI. Pharm. & Exp. Therap. June, 1919.

LIQUOR THYROIDEI.

Assay.—The author employs as standard 0.025 Gm. Iodine in organic combination in 100 Cc. of Liquor—this being based on an average content in the fresh gland of 0.04%, and the weight of the gland as at least 60 grains. The method of estimation is to determine the Iodine content in 10 Cc. of the Liquor on the lines of the process for Thyroideum Siccum.—*q.v.*

As an example we found fresh Thyroid glands to contain 0.063% Iodine. The Liquor made from them contained 0.015% Iodine. This indicated that about 45% of the total Iodine had been extracted by the process. The Dry Thyroid from these glands contained 0.24% Iodine (1 of the Dry preparation was yielded by 3.82 of fresh gland). The average weight of the lobes of these glands was only 23½ grains. It would therefore seem desirable that the Liquor formula should be altered so that a specific volume should be made equivalent to *weight* of gland and be finally standardised to 0.025% organically combined Iodine.

Intravenous Injection of Thyroid Preparations.

Attention has been drawn to this recently in the Daily Press (Oct. 1920).

Caution.—Our experiments showed that Liquor Thyroidei B.P. even with the addition of 0.5% Phenol is not sterile. Further work showed that spores were not killed by boiling for $\frac{1}{4}$ hour in sealed ampoules, but a temperature of 120° C. for $\frac{1}{4}$ hour in the autoclave was sufficient to kill all bacteria.

This treatment causes coagulation of the albuminoid constituents and in all probability is injurious to the active thyroid principle.

Finally experiments were made by the method of partial or intermittent sterilisation at 60° C. for $\frac{1}{4}$ hour for 10 successive days. In this case gelatinisation was less pronounced, but even this preparation was *not sterile*.—W. H. M., Expts., Nov. 1920.

THYROIDEUM SICCUM.

Assay of Iodine in Thyroid Preparations.

The Author advises as standard 0.2% Iodine in Organic Combination

W. H. Martindale's Process.

Weigh 2 Gm. of the Dry Thyroid, mix most intimately with 2 Gm. of crushed Sodium Hydrate in a small glass mortar to produce a uniform powder. Heat in a porcelain crucible about 5 Cm. in diameter until the mixture becomes uniformly grey. Allow to cool. Scrape out the ash carefully into the same mortar, reduce to fine powder, mix intimately with 1 Gm. of powdered Potassium Nitrate; transfer to the crucible, heat over Bunsen flame until white or almost so (blowpipe is not necessary on either occasion). Dissolve the flux in about 50 Cc. of Water. Place the solution in a separator, add about 30 Cc. of Petroleum Ether, and then carefully sufficient 25% Sulphuric Acid in portions to render distinctly acid to litmus paper—shaking slightly with each addition so as to “catch” the Iodine in the solvent as it is liberated. After thorough shaking remove the aqueous layer and repeat the extraction with about 20 Cc. Petroleum Ether and a drop or two of 10% Sodium Nitrite Solution. Combine the Petroleum Ether Liquors, wash with water and titrate with N/500 Thiosulphate. (Note.—For 2 Gm. of a 0.2% preparation about 14 to 16 Cc. of Thiosulphate Solution will be required,—the addition of the Sodium Nitrite Solution is not really necessary).

Commercial samples of Dry Thyroid we have found to show remarkable variation.

Furthermore, the Iodine content in Thyroid Glands varies in different countries and at different seasons. We found in one instance a content of 0.514% in the dry gland (equivalent to 0.1% Iodine in the fresh gland). The time of year in this instance was July. On another occasion in March we found from the same

source 0.24% Iodine in Dry Gland (equivalent to 0.063% in the fresh gland: 1 part of Dry Thyroid was = 3.82 of fresh gland). The average weight of the lobes of these glands was $23\frac{1}{2}$ grains—they varied enormously—from 15 to 90 grains.

Further, we obtained the thyroids from a number of **English South Down Sheep** slaughtered in January, 1912—these glands may therefore be considered as a typical winter collection. The fresh substance yielded 25% Thyroideum Siccum (*i.e.*, 1=4 of fresh gland). The weight of glands was taken within two hours of slaughtering, hence there was no appreciable loss of natural moisture. On assay we found the dry gland to contain 0.368% Iodine equivalent to 0.092% Iodine in the fresh gland. It will be noticed that these glands were apparently drier than our summer supply—whether this is due to season or locality is open to discussion.

According to an American authority,—

Sheep's Glands	may contain up to 0.1% in the fresh gland.	
Pigs' Glands	0.0084 to 0.288%	ditto.
Ox Glands	0.003 to 0.147%	ditto.
Human Glands	0.006 to 0.08%	ditto.

(See also T. B. Aldrich, J.C.S.A. ii./12, 1192). Results in Europe with regard to sheep seem therefore to be better than in the U.S.A.

Temperature of Desiccation of Thyroid Gland.

The SECOND SUPPLEMENT TO THE DUTCH PHARMACOPŒIA, which came into force April 1, 1915, has the Iodine content fixed at 0.4% and the temperature for drying is fixed at 45° C. A lower temperature (30° C.) is better as yielding the greatest proportion of soluble iodine in the product. Experiments have shown that at 45° C. 70% of the iodine becomes insoluble.

6,000 Thyroid lobes (Nov. & Dec. 1917) yielded in our works $7\frac{1}{2}$ lbs. of powder of 0.37% strength.

We think the 0.4% suggestion of the Dutch too high. *Sheep's Glands are specified.*

It should be particularly noted that *Off.* requires the dry thyroid gland of the *sheep*, whereas U.S. IX. allows 'all animals which are used for food by man.' Commercially there is risk of substitution. The **U.S. Product is not official in this country.** It is a much cheaper article.

Ox Thyroid Glands, Dry, contained 0.4187% Organic Iodine, according to our assay recently (W. H. M., Aug. 1920).

A test to exclude Inorganic Iodine is obviously necessary to prevent fraudulent dealing.

Note.—The activity of the thyroid gland is attributed to thyro-globulin, an albuminous substance containing Iodine—the percentage of Iodine may therefore be a measure of the activity of a thyroid preparation provided the glands have not been subjected to any treatment that would cause alteration in this substance.

—B.M.J. i./10, 1242.

References.

The thyroid and parathyroid glands are entirely distinct. The parathyroid contains no trace of Iodine.

It has been suggested that to get the best effect one should give to an animal its own biological sort of thyroid hypodermically, human thyroid should be given to the human animal. It has been reported that thyroid feeding has very marked effect upon the synthesis of urea from ammonia in the liver. The action of the thyroid on the heart is yet without proper explanation. The tachycardia has been explained on the grounds of paralysis of the vagus but more recently the thyroid proteid bodies have been thought to directly injure the heart muscle. **Goitre** has been produced in normal animals by feeding on water from goitrous springs—these animals being found to have hypertrophied hearts. With regard to etiology of goitre, experiments showed that in individuals drinking from a so-called goitrous well gross enlargement of the thyroid was noticeable after a few weeks unless the water was boiled. Water-borne contagion will pass through a Berkefeld filter, but will not stand either boiling or heating to 80° C. for half an hour. The infection is therefore either an organism or a very labile chemical compound. A large number of patients develop Graves' disease immediately following severe emotional disturbance or nervous shock. These individuals of course carry a gland capable of reacting to this kind of stimulation, but it is certain that in 40% of the cases the stimulation occurred just before symptoms developed. Antithyroid Serum treatment etc, stated to be effectual—out of 1,500 cases treated 15 to 20% were failures, 50% cured.—“*Developments in the Physiology and Pathology of the Thyroid Gland.*”—S. P. Beebe. “*New York Medical Journal*,” 8/7/11.

Thyroid Gland, Seasonal Variation.—It is stated that three times as much Iodine is found from *June to November* as there is from *December to May*. To obtain 0.2% Iodine one must mix the products of the high and low season of the year.—*Jl. Biol. Chem.*, 1913, 517; *Y.B.P.*, 1913, 39.

Our own experiments and those of Martin and others do not accord with this—at any rate on dry gland.

Martin, P.J. ii./12, 144, found as average in the dry gland from July to November, 1911, 0.36%, and in fresh gland 0.091%, and from December, 1911, to May, 1912, in dry 0.33%, and in fresh 0.086%. It is however, more instructive to compare the content in the months of April to October inclusive with the November to March figures on the fresh gland. The former are about double the latter owing to more moisture content in the winter. The Iodine yield from dry gland works out about the same throughout the year, viz., 0.34%.

N. H. Martin, in continuing his investigations, arrived at 0.25% as a fair Iodine Standard on examination of 13,927 lobes.—P.J. ii./13, 123.

Glode Guyer made a prolonged investigation from December 12th to June 13th, on the weights of glands and moisture content. He found the ratio of dry to fresh gland as 1 to 3.6. The Iodine content on fat-free dry gland, through the period, supported our suggested standard of 0.2%.—P.J. ii./13, 123.

R. R. Bennett comments further on *Thyroideum Siccum*. He finds the yield to be 25%, in other words, 1 of dry powder = 4 of fresh substance. Martin found (1912) the yield to range from 1 = 2.58 to 1 = 5.66, i.e., an average of 1 = 3.39, subsequently (1913) the average was 1 = 4.15. Glode Guyer found in January, 1913, 1 = 3.34 and in June, 1913, 1 = 4.52. The question is raised as to how the old factor 1 = 5 arose.—P.J. ii./13, 804. Probably weight of fresh substance was taken on inadequately trimmed glands.—W. H. M.

Sheep in the Orkneys in winter consume seaweed, hence the iodine content in Dry Thyroid Gland may be 1.05%.—*Jl. Biolog. Chem.* per P.J. i./15 625.

Iodine is a component part of the protein molecule of the thyroid gland but according to Herzfeld & Klinger it is not an essential constituent of thyroid secretion.—*J.C.S.A.i.* 19, 608.

A water soluble active Thyroid Gland product.—J. M. Rogoff, *Jl. Pharm. & Exp. Therap.*, Oct., 1918, 207. See also ‘Thyroxin,’ Vol. I., p. 934.

Life history of the first case of myxoedema treated by Thyroid.—G. R. Murray, *B.M.J.* i./20, 359.

PLACENTA.

An extractive termed **Placentine**, prepared by extracting minced fresh normal placenta with Absolute Alcohol, evaporating to dryness and taking up the residue with normal Saline Solution. Injection of this preparation causes a striking rise in blood pressure following a preliminary fall on injection—chiefly due to constriction of peripheral arterioles. General effect on the circulation similar to that by Adrenalin, but differed in three ways.—(1) Less rapid rise of blood pressure, (2) more prolonged rise, (3) less marked cardiac effect. Should prove a valuable agent administered prior to anaesthetisation in serious abdominal operations—the more so in view of the frequent use of the Scopolamine-Morphine-Chloroform method.—L. ii./07, 1158; P.J. ii./07, 737.

This chemical substance developing simultaneously with the growth of the placenta probably provides stimulus for the production of labour, as it stimulates the uterus to contract. It should be possible to produce the substance synthetically.

Placentine Solution from sheep, as prepared by the writer, contains 1% of the extractive in Normal Saline.

As anti-reaction in pregnancy.—B.M.J. i./14, 833.

Galactagogue effect from the mother eating the placenta cooked in salt water or broth. Also said to be a remedy in chlorosis and anaemia.

Tablets each = 0.25 Gm. fresh substance stated to be effectual. Daily dose never exceeding 1.5 Gm.—B.M.J. i./17, 203.

Hormones.

Pro-Secretin, the remarkable body found by Bayliss and Starling in the columnar epithelia of the small intestine, is an instance of internal secretion by a tissue, the main function of which is of a different nature. This substance when acted on by dilute acid yields **Secretin**, which after passing into and circulating with the blood provokes the secretion of the gastric juice and to a less extent that of the liver, it (Pro-secretin) exemplifies the class of hormones, bodies which give the character to internal secretions, and which, on absorption into the blood, influence tissues and organs other than those from which they have been obtained.

Experiment at University College showed that an acid extractive of the intestinal lining of a dog injected into the veins caused, when reaching the pancreas, an immediate increase in the flow of the pancreatic juice.

The testes and ovary, the intestinal epithelium, the pancreas, thyroid, the suprarenals and the pituitary body appear to yield specific hormones of physiological importance. It is held by some that the internal secretion of the ovary is produced by the corpus luteum.

Milk secretion is not the result of nerve excitation but is controlled by a hormone from the pituitary body.—E. A. Schäfer, Med. Press, March 19, 1913.

The most important **ductless glands** are the thyroid, parathyroid, pituitary and suprarenal. The cells of a gland have the power of forming one, or possibly more, hormones, each of which has the power of exciting a definite form of chemical activity in those cells for which it has a special affinity. The name **inhibitory hormones** (a contradictory one) is given to substances which, instead of activating, may control or inhibit chemical action.—G. R. Murray, L. ii./13, 201.

Hormones are thought to have the power to correlate and co-ordinate the various body functions (pregnancy, mammary secretions, etc.), but they also destroy toxins and they control one another—this is the “hormone balance.”—Pres., April, 1913. *c.f.* also Vol. I., p. 618.

Toad Extract.—Parotid Secretion of the tropical toad (*Bufo Agua*) has been found to contain two substances—one closely allied to Epinephrin, the other with composition $C_9H_{12}O_2$ apparently belonging to the Digitalis group of poisons—to this latter the name **Bufagin** has been assigned. To its efficacy it is thought the treatment of cardiac dropsy by toadskin in the Middle Ages was possibly due.—A.M.A., May 27/11, p. 1531. See also P.J. ii./11, p. 96

PHYSIOLOGICAL STANDARDISATION.

This method of testing is employed in those instances in which the drug contains no definite crystalline, easily isolated, active principle, *e.g.*, an alkaloid capable of extraction.

It consists in "determination of the change in function induced in living organisms by the administration in the state of minute division of such inorganised substances as do not act merely as foods, for the purpose of identifying and adjusting the strength of drugs; this may be either qualitative or quantitative."

The physiological action of a drug is the affinity it possesses for certain constituents of the protoplasm of the cells of particular organs of the body. Thus Ergot has a specific action on the uterus. Cocaine has affinity for nerve endings, and Strychnine acts similarly on the protoplasm of the spinal cord. Furthermore, as a result of the elective principle, drugs, according to their specific action on the organs, are designated stimulant, depressant, or irritant. The animals used for physiological determination should obviously be of the same species and weight, and should have been grown and kept under similar conditions. It is often useful to divide the small animals (*e.g.*, frogs) into classes according to weight, and use these in 'batches' for experimental investigations. Much comparative work has been done with various **heart tonics**, *e.g.*, Digitalis and Strophanthus (1) by direct application of a solution to the laid-bare frog's heart, and (2) injection intravenously or subcutaneously into dogs, rabbits, &c.

The quantitative test is based on the fact that the killing power of heart tonics for 'similar' frogs is constant per unit of body weight. Comparisons are made between effects produced by the sample preparation under examination and a standard preparation, *e.g.*, a tincture made from genuine Kombé Strophanthus.

U.S. IX. assays Digitalis, Squill and Strophanthus and their preparations by ascertaining the dose of the drug or the preparation which will arrest the heart of a standard sized frog in systole in one hour's time. For further details see Digitalis p. 67, and Strophanthus, p. 146.

Suprarenal Glands and Adrenalin.—

U.S. IX. assays Suprarenal Gland (i.) Colorimetrically (ii.) by comparing the rise in blood pressure produced in a dog of a preparation with that produced by a standard Epinephrin Solution in certain conditions *v.p.* **152.**

ACTION OF ACIDS ON THE COMMON METALS AND THEIR OXIDES.

The reaction between Acids and the Common Metals is a matter frequently arising and one concerning which information is not always available. In arranging the following table it was necessary to check many of the interactions experimentally as we found statements in the literature to vary greatly.

SUBSTANCE.	ACID HYDROCHLORIC.		ACID SULPHURIC.		ACID NITRIC.		REMARKS.
	Conc. Sp. gr. 1.16.*	Dilute. Sp. gr. 1.052.†	Conc. Sp. gr. 1.843.†	Dilute.† Sp. gr. 1.094	Conc.* Sp. gr. 1.42.	Dilute.† Sp. gr. 1.101.	
§ Aluminium							
	Hot.	Soluble. Forms $AlCl_3$.	Soluble. Forms $Al_2(SO_4)_3$	Slowly attacked.	Soluble. Forms $Al(NO_3)_3$ and Oxides of Nitrogen.	Slowly soluble.	Attacked by NaOH or KOH Solutions. Soluble in cold Acetic Acid, quicker in hot.
	Cold.	Ditto.	Slightly attacked.	Unattacked	Scarcely attacked.	No action.	
Aluminium Oxide. (Amorphous) Al_2O_3	Hot.	Slightly soluble. (Forms $AlCl_3$). Ditto.	Slightly soluble.	Soluble. Forms $Al_2(SO_4)_3$	Slowly soluble. Forms Al (NO_3) ₃ . Ditto.	Slowly soluble. Forms Al (NO_3) ₃ . Ditto.	<i>Ignited</i> (Amorphous) Oxide is unattacked by Acids, except hot H_2SO_4 .
	Cold.	Almost insoluble.	Ditto.	Ditto.			
Antimony	Hot.	Pure Antimony is insoluble.	Soluble. Forms $Sb_2(SO_4)_3$ and SO_2	Insoluble	Oxidised but not dissolved.	Oxidised but not dissolved	Aqua Regia dissolves forming Antimonious or Antimonic Chloride according to duration of action.
	Cold.	No action.	No action.	Insoluble.	Practically no action.	No action.	
Antimonic Oxide. Sb_2O_5 .	Hot.	(Forms $SbCl_5$). Slightly soluble.	Soluble.	Slightly soluble.	Practically insoluble.	Very slightly soluble.	Soluble in KOH and NaOH Solutions. Insoluble in NH_4OH .
	Cold.	Slowly soluble to form $SbCl_3$.	Slightly soluble.	Very slightly soluble.	Ditto	Ditto.	

* = Off.

† = Off. approx.

‡ = B.P. '08.

§ See under Chromium.

SUBSTANCE.	ACID HYDROCHLORIC Conc. Sp. gr. 1.16.	ACID HYDROCHLORIC Dilute. Sp. gr. 1.052.	ACID SULPHURIC. Conc. Sp. gr. 1.843.	ACID NITRIC. Conc. Sp. gr. 1.42.	REMARKS
Antimonious Oxide Sb_2O_3	Hot.	Soluble. Forms SbCl_3 more or less according to proportion of Acid.	Soluble.	Forms Sb_2O_5 and Sb_4O_6	Soluble in Acetic, Tartaric and Benzoic Acids, also in Glycerin, Sodium Hydrate and Potassium Hydrate Solutions.
	Cold.	Slowly soluble.	Very slightly soluble.	Slightly soluble. Ditto	Easily soluble in Aqua Regia forming SbCl_3 or SbCl_5 according to length of action.
Arsenium	Hot.	Slowly soluble. Forms AsCl_3 . Practically no action.	Soluble. Forms As_2O_3 and SO_2 . No action.	Soluble. Forms H_3AsO_4 Ditto.	Soluble in Sodium Hypochlorite Solution.
	Cold.	Soluble. Forms AsCl_3 and Chlorine on prolonged boiling.	Soluble.	Soluble. Forms H_3AsO_4 Practically no action.	Very soluble in water.
Arsenious Oxide As_2O_3	Hot.	Soluble. Forms AsCl_3 more or less according to proportions of Acid	Slightly soluble.	Soluble. Forms H_3AsO_4	Soluble in Alkalies.
	Cold.	Slightly soluble.	Slightly soluble.	Slightly soluble, without changing	

SUBSTANCE.	ACID HYDROCHLORIC. Conc. Sp. gr. 1.16.	ACID SULPHURIC. Conc. Sp. gr. 1.843.	ACID NITRIC. Conc. Sp. gr. 1.42	REMARKS.
Bismuth	Hot	Scarcely acted on.	No action	Aqua Regia converts into Bi Cl ₃ .
	Cold.	Insoluble	Ditto	
	Hot.	Soluble. Forms BiCl ₃ .	Slightly soluble. Forms Bi ₂ (SO ₄) ₃ .	Soluble. Bi Forms Bi (NO ₃) ₃ and NO ₃ according to quantity of acid. Scarcely acted on.
Bismuth Oxide Bi ₂ O ₃	Cold.	Ditto.	Ditto.	
	Hot.	Soluble. Forms CrCl ₂ quickly oxidizing to CrCl ₃ .	Slightly soluble. Forms Cr ₂ (SO ₄) ₃ .	Soluble. Forms Ni-trate. Ditto.
	Cold.	Ditto.	Ditto.	Soluble in strong hot NaOH Solution.
Chromium (Reduced from CrCl ₃ by Zn.)	Hot.	Soluble. Forms CrCl ₂ quickly oxidizing to CrCl ₃ .	Practically no action.	'β' Chromium reduced from CrCl ₃ by ignition with Carbon is said to be unattacked by Aq. Regia or any Acids.
	Cold.	Ditto.	Insoluble.	
	Hot.	Soluble. Forms CrCl ₃ .	Soluble. Forms Cr (NO ₃) ₃ (?).	Crystalline Cr ₂ O ₃ is insoluble in all Acids.
Chromic Oxide Cr ₂ O ₃ (Green Amorphous.)	Cold.	Ditto	Ditto.	
	Hot.	Soluble. Forms CrCl ₃ .	Soluble. Forms Cr (NO ₃) ₃ (?).	
	Cold.	Ditto	Ditto.	

* NOTE.—By dissolving strongly heated Chromic Oxide in hot concentrated HNO₃ (1.4) a solution is obtained from which Cr₂(NO₃)₆.15H₂O crystallises on cooling. In dry air this loses 6H₂O with formation of Cr₂(NO₃)₆.9H₂O. Similarly (at NO₃)₆.15H₂O is produced stable in ordinary air.—Milorad Z. Jovitschitsch Monatsh. 1012. 33.9-18 per J.C.S.A. ii./12. 261.

SUBSTANCE.	ACID HYDROCHLORIC.		ACID SULPHURIC.		ACID NITRIC.		REMARKS.
	Conc. Sp. gr. 1.16.	Dilute. Sp. gr. 1.052.	Conc. Sp. gr. 1.843.	Dilute Sp. gr. 1.094.	Conc. Sp. gr. 1.42.	Dilute. Sp. gr. 1.101.	
Chromic Oxide CrO_3 (Red)	Hot.	Soluble. Forms CrCl_3 and Chlorine.	Soluble with- out decom- position un- less the sol- ution be very con- centrated.	Soluble with- out decom- position	Soluble with- out decom- position.	Soluble with- out decom- position.	Very soluble in water to form H_2CrO_4 .
	Cold.	Ditto.	Ditto.	Ditto.	Ditto	Ditto	
Cobalt	Hot.	Soluble. Forms CoCl_2	Attacked. Forms Co (SO_4) and SO_2 .	Soluble. Forms Co (SO_4).	Soluble Forms Co (NO_3) ₂ and Nitro- gen Oxides. Ditto.	Soluble Forms Co (NO_3) ₂ and Oxides of Nitrogen. Ditto	
	Cold.	Ditto.	Unattacked	Ditto.	Ditto.	Ditto	
Cobalt (ous). Oxide	Hot.	Soluble. Forms CoCl_2 .	Soluble. Forms Co (SO_4).	Soluble. Forms Co SO_4 .	Soluble. Forms Co (NO_3) ₂ .	Soluble. Forms Co (NO_3) ₂ .	
	Cold.	Ditto.	Ditto.	Ditto.	Ditto.	Ditto.	
Copper	Hot.	Very slowly soluble. Forms Cu_2 Cl_2 (in con- tact with the air).	Slowly sol- uble. Forms Cu SO_4 , CuS and SO_2 .	Not at- tacked.	Soluble. Forms Cu (NO_3) ₂ and Oxides of Nitrogen	Soluble. Forms Cu (NO_3) ₂ and Oxides of Nitrogen.	Slowly soluble in Con- centrated Solutions of Caustic Alkalies.
	Cold.	Not attacked.	Not attacked.	Not attacked.	Ditto	Scarcely attacked.	

SUBSTANCE.	ACID HYDROCHLORIC. Conc. Sp. gr. 1.16.	Dilute. Sp. gr. 1.052.	ACID SULPHURIC. Conc. Sp. gr. 1.843.	Dilute. Sp. gr. 1.094.	ACID NITRIC. Conc. Sp. gr. 1.42.	Dilute. Sp. gr. 1.101.	REMARKS.
Copper (-ic) Oxide (Black) CuO	Hot. Cold	Soluble. Forms CuCl ₂ . Ditto.	Soluble. Forms CuSO ₄ . Slightly sol- uble.	Soluble. Forms CuSO ₄ . Ditto.	Soluble. Forms Cu(NO ₃) ₂ Ditto.	Soluble. Forms Cu(NO ₃) ₂ . Ditto.	Slowly soluble in hot concentrated caus- tic Alkali Solutions.
Copper (ous) Oxide (Red) Cu ₂ O.	Hot. Cold.	Soluble. Forms Cu ₂ Cl ₂ . Ditto.	Soluble. Forms CuSO ₄ and SO ₂ . Ditto.	Soluble. Forms CuSO ₄ and Copper. Ditto.	Soluble. Forms Cu(NO ₃) ₂ and Oxides of Nitrogen. Ditto.	Soluble. Forms Cu(NO ₃) ₂ and Oxides of Nitrogen. Slightly soluble.	Same as Black Oxide.
Gold	Hot. Cold.	Not attacked. Ditto.	Not attacked. Ditto.	Not attacked. Ditto.	Not attacked. Ditto.	Not attacked. Ditto.	Soluble in Aqua Regia to form AuCl ₃ .
Gold (ic) Oxide. Au ₂ O ₃ .	Hot. Cold.	Slightly sol- uble. Ditto.	Slightly sol- uble. Ditto.	Slightly sol- uble. Ditto.	Soluble Ditto.	Slightly sol- uble. Ditto.	Soluble in Conc. KOH Solution and KCN Solution.
Iron	Hot. Cold.	Soluble. Forms FeCl ₂ . Ditto.	Soluble. Forms Fe SO ₄ and SO ₂ . Ditto.	Soluble. Forms Fe SO ₄ . Ditto.	Soluble. Forms Fe (NO ₃) ₃ and Oxides of Nitrogen. Ditto.	Soluble. Forms Fe (NO ₃) ₃ and Oxides of Nitrogen. Ditto.	

SUBSTANCE.	ACID HYDROCHLORIC. Conc. Sp. gr. 1.16.	ACID SULPHURIC. Conc. Sp. gr. 1.843.	ACID NITRIC. Conc. Sp. gr. 1.42	REMARKS.
Iron (-ic) Oxide. Fe_2O_3 .	Hot. Soluble. Forms Fe_2Cl_6 .	Very slight action.	Practically no action.	Strongly ignited Oxide practically in soluble in all acids.
	Cold. Action practically nil.	Practically no action.	Ditto.	
Lead.	Hot. Action slight. Forms PbCl_2 .	Action very vigorous. Forms PbSO_4 .	Action slow. Forms $\text{Pb}(\text{NO}_3)_2$ & oxides of Nitrogen.	Action greatly depends on the condition of the lead—whether sheet or finely divided, etc.
	Cold. Action very slight.	Action very slight.	Action slight.	
Lead Oxide (Litharge) PbO .	Hot. Soluble. Forms PbCl_2 .	Forms PbSO_4 .	Readily soluble. Forms $\text{Pb}(\text{NO}_3)_2$.	Soluble in conc. KOH and NaOH solutions. Easily in Acetic Acid.
	Cold. Ditto. Easily soluble. Forms MgCl_2 .	Ditto. Soluble. Forms MgSO_4 $\text{MgH}_2(\text{SO}_4)_2$ and SO_2 .	Ditto. Soluble. Forms $\text{Mg}(\text{NO}_3)_2$ Oxides of Hydrogen & Nitrogen	
Magnesium	Hot. Ditto. Easily soluble. Forms MgCl_2 .	Ditto. Soluble. Forms MgSO_4 $\text{MgH}_2(\text{SO}_4)_2$ and SO_2 .	Ditto. Soluble. Forms $\text{Mg}(\text{NO}_3)_2$ Oxides of Hydrogen & Nitrogen	Soluble in Ammonium Chloride Solution.
	Cold. Ditto.	Action very slight.	Ditto.	

SUBSTANCE.	ACID HYDROCHLORIC.		ACID SULPHURIC		ACID NITRIC.		REMARKS.
	Conc. Sp. gr. 1.16.	Dilute. Sp. gr. 1.052.	Conc. Sp. gr. 1.843	Dilute. Sp. gr. 1.094	Conc. Sp. gr. 1.42.	Dilute. Sp. gr. 1.101.	
Magnesium Oxide. MgO	Hot.	Readily soluble. Forms $MgCl_2$.	Readily soluble. Forms $MgSO_4$ & $MgH_2(SO_4)_2$	Readily soluble. Forms $MgSO_4$	Readily soluble. Forms $Mg(NO_3)_2$	Readily soluble. Forms $Mg(NO_3)_2$.	Soluble in Ammonium Salts, also in Organic Acids.
	Cold.	Ditto.	Ditto.	Ditto.	Ditto.	Ditto.	
Manganese	Hot.	Easily soluble. Forms $MnCl_2$.	Soluble. Forms $MnSO_4$ and SO_2 .	Easily soluble. Forms $MnSO_4$.	Easily soluble. Forms $Mn(NO_3)_2$ & Oxides of Nitrogen. Ditto.	Easily soluble. Forms $Mn(NO_3)_2$ & Oxides of Nitrogen. Ditto.	
	Cold.	Ditto.	Action slight.	Ditto			
Manganese Dioxide MnO_2 .	Hot.	Soluble. Forms $MnCl_2$ and Chlorine.	Action slight Forms $MnSO_4$ and Oxygen at $200^\circ C.$ [or $Mn_2(SO_4)_3$ at $100^\circ C.$]. —Schmidt.	Action very slight. Forms $MnSO_4$ and Oxygen.	Action very slight.	Action very slight.	MnO_2 is more soluble in diluted Sulphuric Acid in presence of easily oxidisable bodies ($FeSO_4$, Sugar, etc.), with formation of $MnSO_4$ and O , the O then oxidises the substances in question.
	Cold.	Ditto.	Practically no action.	No action.	No action.	No action.	

SUBSTANCE.	ACID HYDROCHLORIC. Conc. Sp. gr. 1.16.	Dilute Sp. gr. 1.052.	ACID SULPHURIC. Conc. Sp. gr. 1.843.	Dilute. Sp. gr. 1.094.	ACID NITRIC. Conc. Sp. gr. 1.42.	Dilute. Sp. gr. 1.101.	REMARKS:
Mercury	Hot. No action	No action.	Forms HgSO_4SO_2 , and Hg_2SO_4 according to proportions and temperature.	Practically no action.	Soluble. Forms $\text{Hg}(\text{NO}_3)_2$ & Oxides of Nitrogen.	Soluble. Forms $\text{Hg}(\text{NO}_3)_2$ & Oxides of Nitrogen.	
	Cold. Ditto	Ditto	No action.	Ditto.	Soluble. Forms $\text{Hg}(\text{NO}_3)_2$ & some $\text{Hg}_2(\text{NO}_3)_2$ and Oxides of Nitrogen	Very slightly soluble. Forms $\text{Hg}_2(\text{NO}_3)_2$	
Mercury (-ic) Oxide yellow or red variety HgO	Hot. Soluble. Forms HgCl_2 . Ditto.	Soluble: Forms HgCl_2 . Ditto.	Soluble Forms HgSO_4 . Ditto.	Soluble. Forms HgSO_4 . Ditto.	Soluble. Forms $\text{Hg}(\text{NO}_3)_2$. Ditto.	Soluble. Forms $\text{Hg}(\text{NO}_3)_2$. Ditto.	Combines easily with Organic Acids when freshly precipitated
	Hot. Soluble Forms NiCl_2 .	Very slowly soluble. Forms NiCl_2	Action slight. Forms NiSO_4 and SO_2 .	Very slowly soluble. Forms NiSO_4 .	Easily soluble. Forms Ni (NO_3) ₂ and Oxides of Nitrogen.	Easily soluble. Forms Ni (NO_3) ₂ and Oxides of Nitrogen. Ditto.	
Nickel	Cold. Ditto.	Ditto.	Practically no action.	Ditto.	Easily soluble. Forms Ni (NO_3) ₂ and Oxides of Nitrogen. Rendered passive.	Ditto.	
	Hot. Soluble; Forms NiCl_2 . Ditto.	Soluble. Forms NiCl_2 . Ditto	Forms NiSO_4 . Ditto.	Soluble. Forms NiSO_4 . Ditto.	Soluble. Forms $\text{Ni}(\text{NO}_3)_2$. Ditto.	Soluble. Forms $\text{Ni}(\text{NO}_3)_2$. Ditto.	Soluble in NH_4OH .

SUBSTANCE.	ACID HYDROCHLORIC. Conc. Sp. gr. 1.16.	ACID HYDROCHLORIC. Dilute Sp. gr. 1.052.	ACID SULPHURIC. Conc. Sp. gr. 1.843	ACID SULPHURIC. Dilute Sp. gr. 1.094.	ACID NITRIC. Conc. Sp. gr. 1.42.	ACID NITRIC. Dilute Sp. gr. 1.101.	REMARKS.
Nickel (-ic) Oxide Ni_2O_3 :	Hot. Soluble. Forms Ni Cl_2 and Oxygen. Ditto.	Soluble. Forms Ni Cl_2 and Oxygen. Ditto.	Forms NiSO_4 .	Soluble. Forms Ni SO_4 and Oxygen. Ditto.	Soluble. Forms Ni $(\text{NO}_3)_2$ and Oxygen. Ditto.	Soluble. Forms Ni $(\text{NO}_3)_2$ and Oxygen. Ditto.	Soluble in NH_4OH c evolution of Nitro- gen.
Platinum	Hot. No action.	No action.	No action.	No action.	No action.	No action.	Soluble in Aqua Regia to form PtCl_4 .
Silver	Cold. Ditto. Hot. Practically no action.	Ditto. Practically no action.	Soluble. Forms Ag_2SO_4 and SO_2 .	Ditto. Action very slight.	Ditto. Soluble. Forms Ag NO_3 and Oxides of Nitrogen. Ditto.	Ditto. Soluble. Forms Ag NO_3 and Oxides of Nitrogen. Action slight.	Finely divided Sil- ver is more respon- sive than compact Silver to Hydro- chloric Acid.
Silver Oxide	Cold. Ditto. Hot. Forms AgCl	Ditto. Forms AgCl	No action.	No action.	Soluble. Forms Ag_2SO_4 . Ditto.	Soluble Forms AgNO_3 . Ditto.	Soluble in NH_4OH and KCy Solutions.
Tin	Cold. Ditto. Hot. Soluble. Forms SnCl_2 .	Ditto. Soluble. Forms SnCl_2 .	Dissolves forming Sn SO_4 (Stan- nous Sul- phate) SO_2 and Sul- phur. Action slight.	Slowly sol- uble. Forms SnSO_4 .	Soluble. Forms Ag_2SO_4 . Ditto.	Soluble. Forms AgNO_3 . Ditto.	Soluble in hot Con- centrated NaOH or KOH solution. Forms Stannates K_2 SnO_3 or Na_2SnO_3 .
	Cold. Soluble. Forms SnCl_2 .	Practically no action.	Practically no action.	Practically no action.	Forms H_2 SnO_3 (Meta- stannic Acid) Ox- ides of Nit- rogen and NH_4NO_3 . Ditto.	Soluble. Forms H_2 SnO_3 , Sn $(\text{NO}_3)_4$ and Oxides of Nitrogen & NH_4NO_3 . Soluble. Forms $\text{Sn}(\text{NO}_3)_2$ NH_4NO_3 and very little gas.	Aqua Regia in excess dissolves to form Stannic Chloride SnCl_4

SUBSTANCE.	ACID HYDROCHLORIC		ACID SULPHURIC.		ACID NITRIC.		REMARKS
	Conc. Sp. gr. 1.16.	Dilute. Sp. gr. 1.052.	Conc. Sp. gr. 1.843.	Dilute. Sp. gr. 1.094.	Conc. Sp. gr. 1.42.	Dilute. Sp. gr. 1.101.	
Tin (-ic) Oxide SnO_2 .	Hot.	No action.	Slightly soluble.	No action.	No action.	No action.	Slightly soluble in hot conc NaOH or KOH solutions.
	Cold.	Ditto.	No action.	Ditto.	Ditto.	Ditto.	
	Hot.	Soluble. Forms SnCl_2 .	Forms SnSO_4 . Soluble. Forms SnSO_4 .	Soluble. Forms SnSO_4 .	Forms SnO_2 and Oxides of Nitrogen. Ditto.	Forms SnO_2 and Oxides of Nitrogen. Soluble. Forms $\text{Sn(NO}_3)_2$.	Newth says solution in NaOH is known as Sodium Stannite
	Cold.	Ditto.	Ditto.	Ditto.			
Zinc	Hot.	Soluble. Forms ZnCl_2 .	Forms ZnSO_4 & SO_2 .	Soluble. Forms ZnSO_4 and H. SO_4 and H. and if not sufficiently diluted H_2S .	Soluble. Forms $\text{Zn(NO}_3)_2$ Oxides of Nitrogen and NH_4NO_3 .	Soluble. Forms $\text{Zn(NO}_3)_2$ Oxides of Nitrogen and NH_4NO_3 .	Soluble in hot Concentrated KOH and NaOH Solutions.
	Cold.	Ditto.	Forms ZnSO_4 .	Soluble. Forms ZnSO_4 and H.	Soluble.	Soluble.	
	Hot.	Soluble. Forms ZnCl_2 .	Slightly soluble. Forms ZnSO_4 .	Soluble. Forms ZnSO_4 .	Soluble. Forms $\text{Zn(NO}_3)_2$.	Soluble. Forms $\text{Zn(NO}_3)_2$.	Soluble in NH_4Cl NaOH and KOH Solutions.
	Cold.	Ditto.	Ditto.	Ditto.	Ditto.	Ditto.	

INDICATORS.

For use in Volumetric Analysis.

Indicator.	Strength and Solvent.	End Reaction.	Remarks.
Cochineal ..	B.P. employs the <i>Off.</i> Tincture (1 in 10 Alcohol 45 %).	Violet with alkalis, red with acids.	Useless for organic acids. Sharp end reaction with inorganic acids and bases by back titration. Suitable for solutions of the alkaline earths. Used for titrating alkaloids with mineral acids, but end reaction not sharp.
Congo Red ..	0.5 % solution in water.	Red with alkalis, violet with acids.	Responds well to inorganic acids and inorganic bases. Responds to organic bases, but not good for titrating, <i>e.g.</i> Quinine or Atropine.
Dimethyl-amido-azo-Benzol.	1 in 500 in Alcohol 90 %.	Red with acids, yellow with alkalis.	Not affected by CO ₂ . Responds well to inorganic acids and to organic acids also to inorganic and organic bases, <i>e.g.</i> atropine can be titrated with it; but end reaction not good.
Hæmatoxylin ..	0.2 % in Alcohol 90 %. A few drops are <i>q.s.</i>	Violet or purple with alkalis, yellow or orange with acids.	Responds to inorganic and to organic acids. Responds to inorganic bases, and to organic, <i>e.g.</i> alkaloids. Occasionally used in alkaloidal titrations, <i>e.g.</i> Quinine residues with good end reactions.
Iodo-Eosin ..	0.01 % in water. Sometimes 0.01 % in ether is used.	Red with alkalis in aqueous solution, yellow with acids in ether layer.	Used for titrating minute quantities of alkali with N/100 or N/1000 acid and for small quantities of alkaloids which react alkaline to it. In use 10 to 20 Cc. of Ether is added to the titration flask to form a layer above the liquid. Alkalies produce a red in the aqueous layer and acids a yellow in the ether layer.—P.J. i./15, 135, <i>q.r.</i> also for useful set of tables and notes on the matter in general. See also <i>ibid</i> 827. It is not suitable for ordinary titrations.
Lacmoid ..	0.2 % in Alcohol 60 %.	Blue with alkalis, red with acids.	Similar to Litmus. May be of use instead of Methyl Orange, where the solution is coloured.
Litmus .. (See also Azolitmin, p. 89).	<i>Off.</i> Solution.	Violet with alkalis, red with acids.	CO ₂ if present must be removed by boiling. Suitable for inorganic acids. Not suitable for weak acids and alkalies. Quinine, Morphine and Strychnine are neutral to it. The acid in their salts can be titrated, using Litmus as though no base were present.—P.J. i./15, 135. But we find end points are not good. Phenolphthalein is better.

INDICATORS—(Continued).

Indicator.	Strength and Solvent.	End Reaction.	Remarks.
ethyl Orange..	0.1 % in water. A few drops are sufficient.	Red with acids, yellow with alkalis.	Suitable for titrating most inorganic acids. Organic acids do not give good end reaction. Not suitable for Oxalic Acid. Alkaloids are alkaline to, but end reaction not good, <i>e.g.</i> in case of Quinine. CO_2 does not effect Methyl Orange. Alkali carbonates and bicarbonates can be titrated without boiling, but it is not to be used in boiling solutions, nor in alcoholic solutions.
Phenolphthalein.	0.5 % in 60 % Alcohol. Employ a few drops.	Red with alkalis, discoloured by acids.	Acid Phosphates, <i>e.g.</i> NaH_2PO_4 are neutral to Methyl Orange. Usually employed for titrating inorganic and organic acids. Certain organic bases, <i>e.g.</i> the alkaloid Atropine, are alkaline to this indicator. It is possible to titrate them in dilute alcoholic solution with dilute volumetric acid, with a fairly good end reaction, but Morphine, Quinine and Strychnine are not alkaline to it.
Phenolsulphonephthalein.	0.5 % solution in water.	Magenta in alkaline solution, lemon yellow in acid.	Phenolphthalein is not suitable for titrating Ammonia. Where CO_2 is evolved in the titration it is better to use Methyl Orange.
Potassium Chromate.	1 in 10 of water. A few drops of the solution are employed.	Red colour due to formation of Silver Chromate which occurs only after haloid is all precipitated. When blue or green coloration is no longer produced.	Responds to inorganic acids and bases and to organic acids and bases. Can be used to titrate alkaloids, <i>e.g.</i> Quinine. Has been recently advanced for use in media to differentiate typhoid and paratyphoid bacilli, <i>q.v.</i> For titrating haloids with Silver Nitrate in solution. The solution of the haloid must be neutral as Silver Chromate is soluble in acid.
Potassium Ferrocyamide.	1 % solution in water to be freshly made. Drops of it or a few small crystals are placed on a white tile.		Employed for titrating Ferrous Iron with Potassium Bichromate. Also used in titrating phosphate or arsenate with Uranium Acetate Solution. In this case the end point is the <i>appearance</i> of a brown colour on the ferrocyamide crystal (after boiling the solution) due to formation of Uranium Ferrocyamide.

Indicator.	Strength and Solvent.	End Reaction.	Remarks.
Rosolic Acid <i>Syn.</i> Corallin, Aurin.	0.2% in Alcohol 60%.	Pale yellow solution un- affected by acids, inorganic or organic. Changed violet red by alkalis. Formation or disappearance of blue color. Colourless with acids, blue with alkalis. Orange red with alkalis yellow with acids.	Responds to inorganic bases and to organic bases. Atropine gives good end point, Quinine and Morphine bad. Not suitable for use in presence of Ammonia. CO ₂ to be removed by boiling.
Starch ..	0.5% in water boiled and cooled. 0.2% solution in 60% Alcohol.		For titrating oxidisable substances, <i>e.g.</i> Arsenious Acid or Thiosulphate with Iodine or <i>vice versa</i> .
Thymo- phthalein.			Satisfactory for inorganic acids and bases. Does not respond to organic bases.
Turmeric ..	<i>Off.</i> Tincture. (1 Gm. with 6 Cc. Alcohol 90% by maceration).		Responds to inorganic and organic acids, also to inorganic and organic bases. Requires daylight. Not very satisfactory for alkaloïds, except Atropine. Suitable for estimating Boric Acid. Sensitive to Ammonia (1 in 35,000) and Potash (1 in 180,000).

CHART FOR THE RECOGNITION OF ORGANIC CHEMICAL BODIES USED IN THERAPEUTICS.

The following chart is intended to assist in the recognition of a number of organic chemicals, both natural and synthetic, used therapeutically. It frequently happens that the analyst is called upon to identify such substances, and without some aid to guide him the search is sometimes extremely difficult. In working with the chart the tests should be taken in rotation commencing with the action of Heat, afterwards with Heat with Sodium Hydrate, and so on from left to right. It will be found that by a process of elimination, bodies can be identified.

Very often a 'short cut' in the elimination process, *e.g.* the solubility in water or the melting point will prove of assistance before conducting the detailed tests in the chart. The set of **Corroborative Tests** which follow are of importance for the individual substances dealt with.

The data in the chart have practically all been obtained by personal trials in the author's laboratory. It is possible that in some instances reactions found by other workers may differ from results here recorded. This may be due to (a) difference in commercial variety, (b) mode of conducting the test. The following notes show **methods of procedure adopted** :—

HEAT 0.1 Gm. in a 3 by $\frac{1}{2}$ inch test tube in a Bunsen flame.

HEAT WITH SODIUM HYDRATE.—0.1 Gm. of the substance with about five times its weight of crushed Sodium Hydrate, mixed in tube and heated in the gas flame.

SULPHURIC ACID IN THE COLD.—A portion of the substance on a white tile touched with a glass rod dipped in Concentrated Sulphuric Acid.

SULPHURIC ACID HOT.—0.1 Gm. approx. of the substance placed in test tube, 1 Cc. approx. of Sulphuric Acid added and the mixture heated in the gas flame.

NITRIC ACID.—A portion of the substance on a white tile touched with a glass rod dipped in Nitric Acid of Sp. gr. 1.42.

NITROGEN, PHOSPHORUS, SULPHUR and HALOGENS tested for in the usual manner.

SP. GR. and SOLUBILITIES.—In the case of the important substances these are repeated from the body of the "Extra Pharmacopœia." In other cases solubilities have been determined by customary methods.

FERRIC CHLORIDE.—Add a drop or two of Ferric Chloride Test (5%) Solution to about 1 Cc. of 1 in 25 solution in water.

NOTE.—Ferric Chloride with water alone gives brownish color on boiling. In case of a substance, *e.g.*, *Acetanilide* (which does not

color in the cold) giving this also we record the result as 'nil.' The word 'Nil' throughout the Chart indicates no marked characteristic reaction in a few minutes.)

For the BROMINE WATER TEST, FEHLING'S SOLUTION, MAYER'S TEST, GOLD CHLORIDE TEST, PICRIC ACID TEST, and DRAGENDORFF'S TEST, the 1 in 25 solution of the substance is also used, or, if not soluble to that extent, a saturated solution is employed.

For formulæ for preparation of Fehling's, Mayer's, and Dragendorff's Solutions, *vide* pp. 399, 80, 43.

Gold Chloride Solution is used 1 in 20.

Other Alkaloidal Reagents are the following:—

Ammonium Sulpho-molybdate.—Froehde's Reagent.—Ammonium Molybdate 1 Gm. in Concentrated Sulphuric Acid 100 Cc.

Erdmann's Reagent.—Mix 6 drops of Nitric Acid (Sp. Gr. 1.25) with water 100 Cc., add 10 drops of this to 20 Cc. of Concentrated Sulphuric Acid.

Mandelin's Reagent.—Sulpho-Vanadic Acid.—A 1% solution of Sodium Vanadate in Concentrated Sulphuric Acid.

Mercuric Chloride Solution.—1 in 20.

Platinic Chloride.—1 in 20.

Phospho-Tungstic Acid.—Dissolve Sodium Tungstate 100 and Sodium Phosphate 70 in Water 500, and acidify with Nitric Acid.

Phospho-Molybdic Acid.—Sonnenschein's Reagent.—Consists of a solution of Sodium Phosphomolybdate in Nitric Acid, prepared by acidulating a warm solution (50 to 60° C.) of Sodium Phosphate with Nitric Acid, and adding an excess of Ammonium Molybdate Solution. The yellow precipitate is separated, washed with water, acidulated with Nitric Acid and dissolved in a hot solution of Sodium Carbonate (using as little as possible).

The solution is evaporated to dryness and ignited at low red heat till all Ammonium Salts are volatilised, the residue moistened with Nitric Acid and again ignited. The product, consisting of Phosphomolybdate of Sodium, is dissolved in ten times its weight of water, and Nitric Acid (Sp. Gr. 1.42) added until the precipitate at first produced disappears.

Tannic Acid.—A Solution of Tannic Acid 1 in Water 8, and Alcohol 1, freshly prepared.

Wagner's Reagent.—Iodine in Potassium Iodide. Iodine 5, Potassium Iodide 10, Water 100.

(NOTE.—It is important in testing with this Reagent, *e.g.*, in assaying drugs to determine whether sufficiently extracted, to note that water saturated with Ether and then acidulated gives a precipitate of Iodine on adding this reagent. If a precipitate be obtained in this way confirm by adding water. If it is due to Iodine caused by the Ether it will dissolve again.—*Am. Jl. Ph.*, April '09, 177.)

To save space we have found it best to use FORMULÆ in the chart in place of long chemical names, *e.g.*, HCl., NaOH.

Contractions used in the Chart are as follows :—

a.	=after.	mod.	=moderate.
ac.	=acid.	ne	=neutral.
alc.	=alcoholic	or.	=orange.
alk.	=alkaline.	pp.	=precipitate.
arom.	=aromatic.	part.	=partially.
b.	=before.	quick.	=quickly.
bl.	=black.	res.	=residue.
br	=brown.	rediss.	=redissolves.
ch.	=chars.	sl.	=slightly.
col.	=color.	s.	=sine (without).
dec'm.	=decomposes	sns.	=softens.
dk.	=dark.	str.	=strongly.
dist.	=distillate.	sub.	=sublime or sublimate
Drag.	=Dragendorff		
eff.	=effervescent.	v.	=very.
gr.	=green.	vap.	=vapor.
inflam.	=inflammable.	vi.	=violet.
insol.	=insoluble.	wh.	=white.
m.	=melt(s).	yell.	=yellow.
misc.	=miscible.		

The ABBREVIATIONS of AUTHORS' NAMES are in general those used in the body of the "Extra Pharmacopœia."

No.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C)
1	Acetanilide ...	M. sub. vap. burns	Gives off Aniline.	Nil.	Ch. slowly.	Nil.	N.	113°
2	Acetone ...	Evap.c. inflam. vap	Inflam. vap.	Nil.	Ch. quick.	Sl. br.	Nil.	—
3	Acetophenone	Evaps, does not ch.	Br. c. inflam. vap.	Nil.	Ch.	Nil.	Nil.	20°
4	Acetozone ...	Ch. c. sub. & white res.	Br. c. sl. arom. odor.	Sl. br.	Ch.	Sl. br.	Nil.	See bdy
5	Acetyl-para- amido-Salol	M. turns yell. and ch. vap. burns.	Vi. and gives blue col. up sides of tube.	Nil.	Red. vi. slowly.	Nil.	N.	180- 185
6	Acid Aceto- Salicyl ...	M. c Acetic odor. ch. vap. burns.	Nil.	Nil.	Goes br. not ch.	Nil	Nil.	135°
7	„ Acetyl- Coumaric (see TYL- MARIN)	—	—	—	—	—	—	—
8	„ Agaric ...	M. c. eff. ch. br. dist. and inflam. vap.	Nil.	Nil.	Froths. ch. quick.	Nil.	Nil.	137
9	„ Cacodylic	M. ch. Garlic vap. burns c. As. flame	Nil	Nil.	Does not ch.	Nil.	Nil.	—
10	„ Cam- phoric	M. and sub. c. inflam. vap.	Eff. c. pleas. odor.	Nil.	Eff. inflam. gas, ch	Nil.	Nil.	186°
11	„ Carbolic (CRYST.)	M. and evaps.c. inflam. vap.	Nil.	Nil.	Dark red-br. not ch.	Br. c. explo- sion.	Nil.	39°
12	„ Cholalic... (COLALIN).	Part m. c. strange odor. Ch. c. alk. inflam. vap.	Br.	Br.	Dark red-br. Ch. quick.	Br. and gummy	N	Nil.

No.	SP. GR.	SOL. AQ. (1 in)	SOL. ALC. (1 in)	LIT- MUS.	Fe ₂ Cl ₃ b. & a. boil.	BROM. AQ.	FEH- LING, b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC	DRAG
1	—	200	4½	Neut.	Nil.	Wh. pp.	Nil.	Nil.	Nil.	Nil.	Br. pp.
2	.7966 (pure)	Misc.	Misc.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
3	1.03 of liq.	V. sl.	Misc.	Neut.	Nil.	Sl. pp. rediss	Nil.	Nil.	Nil.	Nil.	Br. pp.
4	—	Part.	Part.	Mod. ac.	Sl. buff, pp.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
5	—	V. sl.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
6	—	400	1 in 5	Mod. ac.	Nil b. vi. a.	No pp.	Nil.	Nil.	Nil.	Nil.	Nil.
7	—	—	—	—	—	—	—	—	—	—	—
8	—	Insol.	V. sl.	Neut. (alc. ac.)	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
9	—	½	4	Str. ac.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
10	—	About 200 or more.	About 1½	Mod. ac.	Br. pp. a.	Nil.	Re- duces b.	Nil.	Nil.	Nil.	Nil.
11	—	12	0.16	Neut.	Vi col. b br. pp. a.	Wh. pp. rediss at 1 st	Nil.	Nil.	Bl. pp. comes v. slow.	Nil.	Nil.
12	—	Sl.	Abt. 1	Neut.	Nil b. br. pp. a.	V. sl. pp.	Nil.	Nil.	Nil.	Nil.	V. sl. red- br.

No.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold	H ₂ SO ₄ Hot.	HNO ₃ .	N. & S. & Hal.	M. Pt. (°C.)
13	Acid Cinna- mic	M. wh. sub. & inflam. vap.	Dark- ens v. slowly ; arom. inflam. vap. Nil.	Nil.	Yell. green ch. slowly.	Nil.	Nil.	130°
14	„ Citric ..	M. clear ch. in- flam. vap.	Nil.	Nil.	Eff. in- flam. vap. & ch.	Nil.	Nil.	135- 154°
15	„ Coumaric	M. ch. c. inflam. vap.	Yell. eff. then color- less.	Yell.	Ch. slowly.	Yell. & strong. eff.	Nil.	200°
16	„ Cresylic	vaps., vap. burns	Separ- ates in 2 layers up. dark & lower light.	Nil.	Ch. quick.	Violent eff.	Nil.	—
17	„ Gallic ..	Part n. & ch. Orange sub. & br. vap. burns.	Turns yell.	Dark- ens sl.	Gradu- ally deep red and then ch.	Br. c. eff.	Nil.	Nil.
18	„ Glycero phosph	Evaps. Res. effs & ch. vap. burns.	Eff.	Nil.	Ch.	Nil.	P.	—
19	„ Hippuric	M. to clear, liq. ch. c. inflam. & alk. vap.	Alk. vap.	Nil.	Ch. slowly.	Nil.	N.	187°
20	„ Malic ..	M. c. sub.	Froths, Vap. burns.	Nil.	Ch. vap. burns c. blue flame.	Nil.	Nil.	Abt 180°
21	„ Meconic	Ch. c. wh. sub. & vap.	Orange then color- less.	Nil.	Straw col. not ch.	Nil.	Nil.	Nil.
22	„ Nuclein- ic	Ch. c. odor of burnt feath'rs.	Br. c. alk. vap.	Nil.	Ch.	Gelatin- ises.	N.P.	Nil.
23	„ Oleic ..	Distils c. sl. resi- due ch.	Br., and separ- ates from fused soda.	Br.	Deep- red br., then ch.	Delicate vi col.	Nil.	—

[illegible]

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃	N. P. S. & Hal.	M. Pt. (°C.)
24	Acid Oxalic	M & sub.	Nil.	Nil.	De- comps.	Nil.	Nil.	102°
25	„ Pyrogall- lic	Sub. c. decomp	Br. to green- ish yell.	Yell. col.	Ch. quick.	Br. vio- lent eff.	Nil.	132°
26	„ Salicylic	Sub. vap. burns.	Nil.	Nil.	Sl. br. not ch.	Nil.	Nil.	156°
27	„ Sclerotic	Ch. alk. vap. burns.	Strong Alk. vap.	Nil.	Ch. quick.	Nil.	N.	Nil.
28	„ Stearic ..	Sub. vap. burns.	Nil.	Yell.	Ch.	Nil.	Nil.	50- 55
29	„ Succinic	M. & vol.	Vap. burns	Nil.	Ch. & sl. sub.	Nil.	Nil.	182°
30	„ Tannic ..	Part m. ch. orange sub. & br. in- flam. vap.	Dirty br.	Dirty br.	Br. then deep vi. and ch.	Br. c. eff.	Nil.	Nil.
31	„ Tartaric..	M. ch. vap. burns.	Nil.	Nil.	Eff. vap burns.	Nil.	Nil.	162- 165
32	„ Valerian- ic	Evap. c. str. odors, vap. burns.	Nil.	Darkens sl.	Ch. quick.	Nil.	Nil.	
34	Acoine ..	M. yell. liq. ch. alk. vap burns.	Bl floats on soda & gives Isoni- trile like odor.	Sl. eff. other- wise nil.	Ch. quick.	Br. to bl	N. & Cl	173°
35	Aconitina ..	Ch. c. acid vap.	Fruity odor at first.	Nil.	Ch. c. Ac Benzoic odor.	Nil.	N.	199 ap- prox.
35a	Acriflavine..	Bl. Red ac. vap.	Ch. vap. turns litmus gr.	Eff. gr. fluores- cent sol.	Ac. vap. (H Cl).	Nil.	N. Cl.	
35b	Adalin ..	Part sub. ac. vap.	Alk. vap. NH ₃ * alc.	Nil.	Ch. ac. vap.. SO ₂ , H Br.	Nil.	N. Br.	116
36	Adrenalin ..	Red'sh ch. alk. vap.	Br. froth Bl. alk. vap.	Yell. col.	Ch. quick.	Yell. br. c. sl. eff.	N.	—
37	Æsculin ..	M. c. sl. eff. ch. yel. dist. vap. burns.	Froths, darkens sl. vap burns.	Darkens sl.	Red br. ch. quick	Yell. br. c. sl. eff.	Nil.	—
38	Æthyl Bromid	Evap.	Nil.	Nil	Nil	Nil.	Fr.	—

[illegible]

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
39	ÆthylChlorid	Evap	Nil.	Nil	Nil.	Nil.	Cl.	—
40	Æthyl Iodid	Evap.	Nil.	Nil.	Gives off. I.	Sl. dark- ening.	I.	—
41	Albumin Tan- nas	Ch. c. odor of burnt feathers Br. alk. vap. burns.	Br. c. odor of burnt feathers alk. vap.	V. dark br.	Ch. immedi- ately.	Br. & swells up.	N. & S.	—
42	AlcoholMeth- ylic	Evap.	Br.	Ch.	Ch.	*Br.	Nil.	—
43	AldehydeAbs	Evaps.	Ch.	Instant ch. & swells up.	h. im- me- diate.	Dark- ens sl.	Nil.	—
43a	Allantoin	M. ch. alk. vap.	Alk. vap. inflam.	Nil.	Red sol.	Nil.	N.	Dec- omp
44	Alloxan ..	M. to dark red br. liq. ch & gives HCN. odor.	Blue in cold & color- less on heating alk. vap.	Nil.	Yell. but does not ch.	Nil.	N.	—
45	Aloes Barb.	Part m. br. yell. vap. burns. br. dist.	Red to br. col.	Br.	Ch.	Red.	Nil.	—
46	„ Cape ..	Part m. br. vap. burns.	Red to br. col.	Br.	Ch.	Dirty br.	Nil.	—
47	„ Soc. ..	Part m. br. yell. vap. burns. br. dist.	Red to br. col.	Red Br.	Ch.	Red-br.	Nil.	—
48	Aloin ..	M. & Ch. vap. burns.	Ch.	Br.	Ch.	Deep red.	Nil.	45

No.	SP. GR.	SOL. AQ. (1 in-)	SOL. ALC. (1 in-)	LIT- MUS.	Fe ₂ Cl ₃ b. & a. boil.	BR. AQ.	FEL- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
39	v. Vol. I.	Sl.	Read- ily	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
40	1.94	400	Misc.	Sl. ac	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
41	—	Sl.	Sl.	Sl. acid.	B. col. b. Br. pp. a.	Nil.	Nil.	Nil.	Dark dirty br. pp.	Nil.	Nil.
42	0.796 to 0.81.	Misc.	Misc.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
43	0.7876	Misc.	Misc.	Mod. ac.	Nil.	Nil.	Re- duct. b.	Nil.	Nil.	Nil.	Nil.
43a	—	260	5000	Ac.	Nil. b. red. pp. a.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
44	—	Sl.	Sl.	Ac.	Nil.	Nil.	Nil.	Nil.	Sl. blue col	Nil.	Nil
45	—	Part. sol.	6 in- com- plete.	Faint ac.	Vi. br.	Yell. pp.	Br. gr.	Nil.	Re d col.	Nil.	Br pp.
46	—	Part, sol.	2	Faint ac.	Vi. br.	Yell. pp.	Br. col.	Nil.	Br. pp.	Nil.	Br. pp.
47	—	Part. sol.	8 in- com- plete.	Faint ac.	Vi. br.	Yell. pp.	Br. gr.	Nil.	Nil.	Nil.	Br. pp.
48	—	140	20	Faint ac.	Vi. br. b. & a.	Yell. pp.	Br. col. b. & a.	Nil.	Red col.	Nil.	pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N P. S. & Hal	M. Pt. (°C)
49	Alphogen ..	First eff. ch. c. cryst. sub.	White cryst. sub. & ch.	Nil.	Eff. & ch.	Eff. no col.	Nil.	262° c. de- com Nil.
50	Aluminii .. Aceto-Tart.	Ch. vap burns.	Vap. burns.	Nil.	Ch.	Nil	Nil.	
51	Alypin ..	M. c. eff. then ch. Alk. vap. burns.	M. & floats on soda.	Eff. str.	Goes br., not ch.	Nil.	N. & Cl.	169
52	Amylene Chloral Sol. 1 : 1	Evaps. vap. burns.	Nil.	Dark'ns sl.	Separ- ates, vap. burns c. gr. flame.	Nil.	Cl.	—
53	Amylene Hydrate	Evaps.	Nil.	Nil.	Ch.	Nil.	Nil.	—
54	Amyl Nitris	Evaps. sl res. ch.	Gr. c. Alk. vap.	Blue, rapidly to br.	Ch.	Darkens slowly.	N.	—
55	Amyl Val- erianas	Evaps. vap. burns.	Ether'l odor, vap. burns.	Darkens sl.	Dark rd. br., ch. & vap. burns. c. galie odor.	Nil.	Nil.	—
56	Anæsthesine	M. evap. vap. burns.	Froths sl. and vap. burns.	Ch. v. slowly.	Ch. Nil.	Nil.	N.	89
57	Anhydro- Glyco- Chloral	M. ch. c. br. dist.	Br. c. caramel odor vap. burns.	Nil.	Ch. quick c. Chloral odor.	Nil.	Cl.	187°
58	Aniline ..	Evaps.	Nil.	Forms br. solid and gets hot.	Ch. slowly	Forms pink solid.	N.	—
59	Anthrarobin	Br. sub. wh. res.	v. deep purple.	Dark br.	Red br. sol. & ch. quick.	Eff. nearly br.	Nil.	—
60	Antim. Pot. Tart.	Black- ens, grey- wh. sub.	Bl.	Nil.	Ch. quick.	Nil.	(Antim. in bl. residue).	—

NO.	SP. GR.	SOL. AQ. (1in—)	SOL. ALC. (1in—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
49	—	100	35	Mod. ac.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
50	—	1 slowly.	In- sol.	Mod. ac.	Nil b. buff, pp. a.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
51	—	1	4	Neut.	Nil.	Yell. pp.	Pale bl. pp. b. oily drops a.	Wh. pp.	Buff pp.	Yell pp.	Red- brl. pp.
52	1.134	Misc. col, thrown out again c 2, r'dis. in 3	Misc.	Neut.	Nil.	Nil.	Light blue pp. b. re- duct a.	Nil.	Nil.	Nil.	Ni.
53	0.815- 0.820	8	Misc.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
54	0.870 0.880	Sl.	Misc.	Sl.ac.	Nil.	Nil.	Nil.	Br. col.	Nil.	Nil.	Bl. pp.
55	0.858	v. sl.	Misc.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
56	—	Sl	8	Neut.	Nil.	Yell. pp.	Nil.	Nil.	Br. pp.	Nil.	Nil.
57	—	Sl.	40	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil
58	—	30	Misc.	Sl. alk.	Br. pp. b	Wh. pp.	Blue pp. b. diss. a.	Nil.	Dark br. pp.	Nil.	Br. pp. to dirty yell
59	—	v. sl.	80	Neut.	Bl. pp.	Dirty br. pp.	Deep red col. b. and a.	Nil.	P'rple col.	Nil.	Nil.
60		15	insol.	Faint ac.	Yell. pp.	Nil.	Nil.	Nil.	Nil.	Nil.	Fe color- ises.

No.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ NO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
61	Antipyrin. see Phenazon	—	—	—	—	—	—	—
62	Aphrodine ..	M. to br liq. c, beastly odor, ch. alk. vap. burns.	M. to br mass on surface of NaOH.	Nil.	Pink-vi then gr. br.	Gr. yell.	N. & Cl.	—
63	Apiol (Green Liquid)	Goes br. br. dist.	Goes bl & gives milky dist. pung. & wh. vap.	Br. and viscid.	Ch. c. much eff.	Eff. sl. c. br. col.	Nil.	—
64	Apocodeine HCl.	Smell of burnt feathers.	Alk. vap.	Dark- ens sl.	Ch.	Eff. and turns br.	N. & Cl.	Prt. a 90 de- c'm. ov'r 200
65	Apomorphine HCl.	Ch. c. wh. vap.	Dark'ns	Nil.	Ch.	Crim. to yel. in 2 mins.	N. Cl.	—
66	Arbutin ..	M. c. sl. eff then ch. br. dist. & vap. burns.	Froths a lot, darkens vap. burns.	Red col	Dark red and ch. quickly.	Red-br. sl. c. eff.	Nil.	166
67	Argenti Fluorid.	Vap. corrod's glass.	Nil.	Nil.	Wh. vap. corrod's glass.	Nil.	F.	Nil.
68	Argenti Lactas	Ch. vap. burns.	Bl.	Nil.	Nil.	Nil.	Nil.	Nil
69	Argenti Proteinas	Ch. br. dist. alk. vap. burns.	Bl. wells and alk. vap burns.	Nil.	Ch. almost immed and vap. burns.	Nil.	N.	—

NO.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD OIL.	ACID PIC- RIC.	DRAG
61	—	—	—	—	—	—	—	—	—	—	—
62	—	Sl.	130	Neut.	Nil.	Yell. pp. rediss. at first	Wh. pp. b. & a.	Wh. pp.	Vi. br. pp.	Yell. pp.	Red br. pp.
63	1.07	Prac. insol.	Part.	Frac. Neut	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Br. pp.
64	—	1	1	Neut.	Drkns. b. & a.	Dirty br. pp.	Drkns. b. drty. gr. pp. a.	Dirty buff pp.	Dirty br. pp.	Yell. pp.	Br. pp.
65	—	60	51	Neut.	Vi. b. & a.	Red pp.	Nil.	Wh. pp.	Br. rd. pp.	Yell. pp.	Br. pp.
66	—	10	13	Neut.	Blue b. br. a	Yell. pp. c. excess br.	Nil.	Nil.	Gr. cl. coming slowly to br. pp.	Nil.	Nil.
67	—	2	3	Faint- ly alk.	Wh. pp.	Wh. pp.	Bl. pp.	Yell. pp.	Light choc. pp.	N dle cryst. on st'nd- ing.	Br. pp. to wh
68	—	18	500	Neut.	Wh. pp.	Wh. pp.	Bl. pp.	Yell. pp.	Light br. pp	Sl pp.	Brpp to wh
69	—	Imper- fectly	V. sl.	Sl. alk.	Sl. opale- scence b, fr'thy a.	Wh. pp.	Nil. b. br. col. a.	Light- ens in col.	Nil.	Yell. flocy pp.	Br. pp. turn- ing wh.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
70	Argonin ..	Ch., br. dist., alk. vap.	Bl. c. strong alk. vap.	Yell.	Ch.	Nil.	N.	Nil.
71	Argyrol ..	Swells up & Ch.	Alk. vap.	Grey.	Ch.	Wh. & eff.	N. & S.	Nil.
72	Arrhena ..	Ch., bl sub. garlic odor.	Nil.	Nil.	Nil	Nil.	Nil.	Nil.
73	Arsamin ..	Ch. bl. sub. & alk. vap.	Nil.	Nil.	Ch. v. slowly.	Nil.	N.	—
73a	Arseno- benzol	Ch. ac. vap. and odor.	Ch. alk. vap. odor like Pyridine.	H ₂ S evolved yell. sol.	Colorless then gr. SO ₂ .	Vigorous br. col.	N. Cl.	—
74	Asparagin ..	Red br., alk. vap	Darkens alk. vap	Nil.	Ch. slow.	Nil.	N.	—
	Aspirin <i>see</i> Ac. Aceto- Salicyl	—	—	—	—	—	—	—
75	Atropine Methyl Brom.	M. c. sl. eff. ch. & gives. br. dist. & irrit. vap.	Red br. and gives alk. vap.	Eff. and turns sl. yell.	Ch. quick.	Nil.	N. & Br	214
76	Atropine and Salts	Base m. and sub. b. ch. salts m. and ch.	Br. pungent alk. vap burns	Nil.	Ch.	Nil.	N. (S. in Atro- pine Sulph.)	P'se 115° Sul. 187°
	Barbitone <i>see</i> Malourea	—	—	—	—	—	—	—
77	Benzol ..	Evap. vap. burns.	Nil.	Nil.	Ch. slowly vap. burns.	Nil.	Nil.	Nil.
78	Benzyl Benzoate .	Distils un- changed.	Benzyl alc. odor.	Yell. pp.	Tarry matter.	Nil.	Nil.	20

[illegible]

No.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. ("C.)
79	Betaine HCl.	Part m., ch. c. eff. and alk. vap. burns.	Alk. vap.	Eff.	Eff. not ch.	Nil.	N. Cl.	—
80	Betol.	M. turns yell. part evap. ch. vap. burns.	Yell.	Nil.	Goes from yell. to gr. bl. and ch.	Nil.	Nil.	95
81	Bismuthi Benzoas	Bl. c. yell. sub. and wh. vap. c. Benzoic odor.	Bl. c. B'nzene odor, vap. burns.	Nil.	Nil.	Nil.	Nil.	Nil.
82	„ Citras	Bl. c. bl. sub.	Bl.	Nil.	Eff. and vap. burns ch. slowly	Nil.	Nil.	Nil.
83	„ Oxy-Iodogall.	Iodine vapour (bl.)	Nil.	Ch.	Strong Iodine (vi.) vap.	Eff. & I. vap. emitted.	I.	—
84	„ Salicyl	Blackens vap. c. odor of Phenol burns.	Bl.	Nil.	Gradually goes br. eff.	Br. in parts only.	Nil.	Nil.
85	„ Subgallas	Goes bl. vap. burns.	Goes bl.	Nil.	Turns red c. wh. pp. then bl.	Dark gr. & eff finally br.	Nil.	Nil
86	Bromal-hydrate	M. wh. vap. colors flame green.	Bromo-form odor.	Nil.	M. does not mix, yell. dist.	Sl. yell.	Br.	54
87	Bromethyl Formine	Eff. ch. c. alk. vap.	Wh. alk. vap. c. Pyridin odor burrs.	Sl. br.	Yell. vap. col. flame gr.	Sl. yell. to br.	Br. N.	200 Schmdt

No	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a boil.	BR. AQ.	F'EH- LING'S b. & a. boil.	MAY- ER'S.	GOLD OHL.	ACID PIC- RIC.	DRAQ
79	—	2	About 20	Acid.	Nil.	Pp. rediss. at first.	Nil.	Nil.	Nil.	Cryst. pp. in conc. Nil in di- lute.	B pp.
80	—	Alm'st insol.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
81	—	Alm'st insol.	Al- most insol.	Sl. acid.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
82	—	Alm'st insol.	Insol.	Faint acid.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
83	—	v. sl. Iodide & Gallic Acid go into s'l'tion	In- com- ple- ly sol.	Sl. ac.	Bl.	Nil.	Nil.	Nil.	Yell. pp.	Nil.	Nil.
84	—	Alm'st insol.	Al- most insol.	Neut.	Vi. col. turns br. a.	Yell. pp.	Nil.	Nil.	Nil.	Nil.	Nil.
85	—	Insol.	Insol.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
86	—	2½	½	Neut.	Nil.	Nil.	V. light bl. pp. b. dis- solves a.	Nil.	Nil.	Nil.	Nil.
87	—	0.6	25	Neut.	Nil.	Yell. pp.	Nil b. sl. reduc. a.	Yell. pp. chang- ing to wh.	Br. yell. pp.	Cryst. pp. come- slow ly.	Red br pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃	N. P. S. & Hal.	M. Pt. (°C.)
88	Brometone ..	M. sub. and ch c. v. irri- tating vap.	Vap. burns.	Nil.	Forms red drops v. irritat- ing vap.	Nil.	Br.	167
89	Bromoform	Dist. then ch c. br. vap. Brom. odor.	Dark'ns & vap. flame gr.	Nil.	Goes br. with br. vap. & then color- less.	Nil.	Br.	—
90	Bromo- Valerianyl- Urea.	M. ch., orange sub. and vap. burns.	Str. alk. vap. burns, darkens sl.	Nil.	Red br. c. valer- ian odor, no ch.	Nil.	N. and Br.	145
91	Butyl Chloral	Sub. totally.	Dark'ns	Nil.	Ch.	Nil.	Br.	78
92	Caffeine ..	Sub. & m.	Sl. sub. & alk. vap.	Nil.	Yell. slowly, no ch.	Nil.	N.	236°
93	Caffeine Citras	M. ch. c. br. dist. & sl. vap. burns c. Phenol odor.	Alk. vap. & eff. a lot.	Deli- cate pink.	Eff. & ch. slow.	Nil.	N	162°
94	Caffeine So- dio- Salicyl.	Part M. sub. c. alk. vap.	Alk. vap. & eff. a lot.	Nil.	Ch. slow.	Nil.	N.	Nil.
95	Calcii di- Bromo- behenas	Part m. ch. c. gr. br. dist' vap. burns.	Oily odor and darkens sl.	Sl. br.	Br. and ch. c. much eff.	Oily	Br.	Abt 230
96	Calcii Gly- ceroph.	Ch. acid vap. burns.	Eff. vap. burns. Sl. black- ens.	Nil.	Ch.	Nil.	P.	Nil.
97	Calcii Lactas.	M. swells & ch.	Eff. vap burns.	Nil.	Eff. ch. vap. burns c. blue flame.	Nil.	Nil.	Nil.

NO.	SP. GR.	SOL. AQ. (1in—)	SOL. ALC. (1in—)	LIT- MUS.	Fe ₂ Cl ₃ b & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD OHL.	ACID PIC- RIC	DRAG
88	—	200	1	Neut.	Nil.	Nil.	Gr. pp. a.	Nil.	Nil.	Nil.	Nil.
89	2.833	Sl.	Misc.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
90	—	Sl.	10	Neut.	Buff pp. a.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
91	—	43	2	Neut.	Nil.	Nil.	Pp. b. nil a.	Nil.	Nil.	Nil.	Nil.
92	—	80	40	Neut.	Nil.	Nil.	Crys. pp. b., re- diss. a.	Nil.	Sl. pp.	Nil.	Br. pp.
93	—	32	25	Acid.	Nil b. & a.	Nil.	Crys. pp. b., re- diss. a.	Nil.	Sl. pp.	Nil.	Br. pp.
94	—	2	40	Prac. Neut.	Red- vi., b., pp. a.	Wh. pp.	Nil.	Nil.	Nil.	Nil.	Br. pp.
95	—	Insol.	Pract. insol.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
96	—	23	Al- most insol.	Alk.	Nil b. buff pp. a.	Nil.	Nil. b., blue pp. a.	Nil.	Nil.	Nil.	Nil.
97	—	15 or less when fresh.	In- sol.	Neut.	Nil	Nil.	Nil.	Nil.	Nil.	Nil.	Nil

No.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃	N. P. S. & Hal.	M. Pt. (°C.)
96	Calcii Saccharas	Ch. c. caramel odor.	Br. & vap. burns.	Br.	Ch. at once.	Eff. sl.	Nil.	Nil.
97	Camph. Mono-brom.	M. c. camph. odor & sub.	Camph. odor. vap. burns.	Nil.	Yell. & ch. quick.	Liquefies.	Br.	76
99	Cantharidin.	M. sub. vap. burns.	Dark ens.	Nil.	Ch. quick.	Nil.	Nil.	218
100	Capsicin	Boils, irrit. vap. burns.	Irrit. vap. burns.	Ch. at once.	Ch. at once, c. eff.	Nil.	Nil.	—
101	Carbamide. See UREA.	—	—	—	—	—	—	—
102	Chinolin	Evaps. & vap. burns.	Vap. burns.	Gets hot & solid.	Br. slow.	Forms crystals slowly.	N.	—
103	Chinosol	M. c. eff.	Bl. c. odor like Chin'lin.	Nil.	Br. slow.	Eff. sl. gives br.	N.S.	172
104	Chloralamid	M. sub. c. chloral odor.	Eff. alk. vap. c. Isonitrite odor. alk. vap. burns.	Nil.	Eff. c. Chloral odor no ch.	Nil.	N.Cl.	115
105	Chloral Hydras	M. sub. c. distinctive odor.	Eff. a lot.	Nil.	Irrit. vap. not ch.	Nil.	Cl.	48— 49
105a	Chloramine —T.	Ac. Vap. odor of p-toluene sulph. chloride	Alk. Vap. Fishy odor	Chlorine	sl. darkening. chlorine	Chlorine	N.Cl.	Decomp

NO.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
96	—	10	In- sol.	Alk.	Pp. b., nil a.	Nil.	Nil.	Nil.	Sl. yell. pp.	Nil.	Sl.br. pp.
97	—	Insol.	18	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
99	—	400	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
100	0.918	V. sl.	Misc.	Sl. ac.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Red br.
101	—	—	—	—	—	—	—	—	—	—	—
102	1.09	Sl.	Misc.	Sl. alk.	Nil.	Yell. pp.	Sl. pp b., nil. a.	Wh. pp.	Orm. pp.	Yell. pp.	Red- br. to bl.
103	—	1	Sl.	Sl. ac	Dark green pp. b. bl., a.	Yell.	Yell. gr. b. & a.	Orm. pp.	Buff pp.	Yell.	Red- br. to bl.
104	—	20	2	Neut.	Nil.	Nil.	Nil b. red a.	Nil.	Nil.	Nil.	Nil.
105	—	0.25	0.2	Neut.	Nil	Nil.	Blue pp. b., re- duc- tion and smell CHCl ₃	Nil.	Nil.	Nil.	Nil.
105a	—	7	Sol. c. de- comp.	Ac.	Buff pp.	White pp.	Nil.	Yell. col. folld. by pp.	Nil.	Yell. sol. gr. fluor.	Br. tarry pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
106	Chloretone ..	Wh. sub. & irrit. vap.	Br. vap. burns c. gr. edg. flm.	Nil.	Eff. c. irrit. vap.	Nil.	Cl.	80
107	Chrysarobin (ACID CHRY- SOPHANIC)	M. ch. & yell. vap. burns.	Black- ens.	Yell.	Deep red ch. quick.	Nil.	Nil.	152- 4
108	Cimicifugin	Br. dist vap. burns.	Nil.	Br.	Ch. quick.	Br.	N.	Nil.
109	Cinchonidine	M. ch. & alk. vap. burns.	Orange br. & floats on soda.	Nil.	Ch. slow.	Nil.	N.	202
110	Cinchonine ..	M. ch. c. burnt feather odor & alk. vp. hns.	Alk. vp. Pyridine odor.	Nil.	Ch. slow.	Nil.	N.	255
111	Cinnamic Aldehyde	Evap. res. ch. vap. burns.	Br. c. aromat. vap. burns.	Ch. immed.	Ch. at once	Goes darker & solid.	Nil.	—
112	Citrophen ..	M. c. de- comp. yell. sb. vap. burns.	Alk. vap. burns.	Nil.	Eff. ch. slowly vap. burns	Blue.	N.	170C dec- omp
113	Citric Acid vide ACID	—	—	—	—	—	—	—
114	Cocaine ..	M. c. yell. dist. ch. & slk vap. burns.	Turns buff col. c. alk. vap.	Nil.	Turns br. ch.	Nil.	N.	98
115	Cocaine Hydrochlor	M. c. eff. to yell. liq ch. & alk vap. burns.	Buff col. c. alk. vap.	Eff.	Turns br. ch.	Nil.	N. & Cl.	1820 dec- omp
116	Codeine Hydrochlor	M. to br. liq. c. eff. ch. br. dist. & vap. burns.	Br. c. alk. vap.	Eff. darkens sl.	Effs. trns sl. vi. then br. & ch.	Eff. c. yell-br. col.	N & Cl.	255

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALQ. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
106	—	200	1½	Neut.	Nil.	Nil.	Nil b. gr. to yell. pp. a.	Nil.	Nil.	Nil.	Nil.
107	—	V. sl.	V. sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
108	—	Sl.	1	Neut.	Nil b. stringy pp. a.	V. sl. pp.	Nil. b. sl. red pp. a.	Nil.	Nil.	Nil.	Sl. br pp.
109	—	V. sl.	20	Prac. neut.	Nil.	Yell. pp.	Nil.	Wh. pp.	Buff pp.	Yell. pp.	Red br. pp.
110	—	V. sl.	175	Prac. neut.	Nil.	Yell. pp.	V. sl. pp. b. floccy wh. pp. a.	Wh. pp.	Buff pp.	Yell. pp.	Red br. pp.
111	1.057	Sl.	Misc.	Prac. neut.	Nil.	Sl. floccy pp.	Nil.	V. sl. pp.	Nil.	Nil.	Red br. pp.
112	—	180	Sl.	Acid	Sl. pp b. deep red col. & pp.	Yell. pp.	Nil.	Nil.	Vi. pp.	Nil. at first yell. d'l'c't crysts form slwly	Nil at first grad. goes vi.
113	—	—	—	—	—	—	—	—	—	—	—
114	—	Sl.	10	Alk.	Nil.	Yell. pp.	Nil.	Wh. pp.	Buff pp.	—	Red br. pp.
115	—	0.5	2½	Neut.	Nil. b. sl. br. pp. a.	Yell. pp.	Wh. pp b. to oily drops a.	Wh. pp.	Yell. pp.	Yell. pp.	Red br. pp.
116	—	30	26	Neut.	Nil.	Yell. pp. rediss. at first	Nil.	Wh. pp.	Lt. br. pp.	Yell. pp.	Red br. pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
117	Colchicine ..	M. c. d'comp. ch. alk. vap. burns.	Turns deep br. c. alk. vap.	Br.- yell.	Br. to deep red.	Deep vi.	N.	143 de- com at 147
118	Colchicine Salicyl.	M. c. d'comp. ch. alk. vap. burns.	Deep. br. c. alk. vap.	Br. yell.	Br. to deep red.	Deep vi.	N.	55- 60
119	Coninæ HBr.	M. and evaps. c. br. dist.	Alk. vap. burns.	Br. yell.	Red br. no ch. c. br. vap.	Nil.	N. and Br.	214
120	Cotarnin HCl.	Deep red & m. partly ch. & br. alk. vap. burns.	Red c. nause- ous odor, then br. alk. vap. burns.	Eff. & darkens sl.	Deep ma- genta slowly. Does not ch.	Br. orange.	N. & Cl.	Abt 191 Hag- ger (Pt. 125) (see also text 98)
121	Cotarnin Phthalas	M. to deep red liq. Ch. br. dist. & alk. vap. burns.	Br. c. nause- ous odor & alk. vap.	Gr. yell.	Ma- genta & does not ch.	Orange.	N.	
122	Coumarin ..	M. and evap. vap. burns.	Yell. vap. burns.	Nil.	Br. no ch.	Nil.	Nil.	67
123	Crede's Silver	Br. sub. & alk. vap. burns.	Alk. vap. burns.	Nil.	Nil.	Eff. and dirty grey col.	N.	Nil.
124	Cresylic Acid <i>vide</i> ACID.	—	—	—	—	—	—	—

[illegible]

No.	SUBSTANCE.	HEAT.	HEAT. c. NaOH.	H ₂ SO ₄ . Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
125	Cryogenin ..	M. ch. str. alk. vap. burns.	Alk. vap. burns.	Sl. pink	Deep blue and ch.	Eff. and br. col.	N.	170
126	Cubebin ..	M. ch. c. br. dist. & vap. burns.	Yell. mass floats on soda	Deep red.	Deep red ch. quick.	Br. to gr.	Nil.	128
127	Dextrose (Commercial).	Ch. odor of burnt sugar, br. sub.	Goes br	Nil.	Ch. immed.	Nil.	Nil.	Nil.
128	Di-Bromo Tannin Gelatin	Ch. c. nitro- genous odor.	Br. c. eff.	Darkens sl.	Ch.	Yell. br. c. eff.	Br. N.	Nil.
129	Diacetyl- Morphine	M. then ch. alk. vap. burns.	Deep orange sl. alk. vap.	Sl. br.	Ch. fairly quick.	Yell.	N.	169
130	Diacetyl- Morphine HCl.	M. to br liq. c. sl. eff. alk. vap. burns.	Deep orange froths a lot sl. alk. vap.	Sl. br. c. sl. eff.	Ch. fairly quick.	Yell.	N. & Cl.	233
131	Dial... ..	Ac. vap. garlic odor.	Alk. vap. odor burnt feathers.	Nil.	Ch. SO ₂	Nil.	N.	170
131a	Di-Chlor- amine T.	M. then explodes odor of p. Toluene sulph. chlor.	Alk. vap. fishy odor.	Cl.	Ch. Cl.	Cl.	N. Cl.	Dec- omp
132	Digitoxin ..	M. ch. yell. dist. vap. burns.	Goes dark & floats on soda as a bl. mass	Ch. to br. mass.	Chars immed.	Yell. to vi.	Nil.	240
133	Elaterin ..	M. to yell. liq.	Yell. then br. mass.	Br.	Deep red br. & ch.	Nil.	Nil.	209
134	Emetina ..	Part m. & ch. alk. vap. burns.	Floats as br. mass on soda.	Dirty br.	Br. & ch. slowly.	Br.	N.	69

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT. MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
125	—	100	25	Neut.	Nil.	Nil.	Gr. col. b reduc- tion a	Nil.	Bl. br. pp.	Nil.	Blr. yel. crysts from sl'wly Nil.
126	—	V. sl.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
127	—	Misc.	Sl.	Neut.	Nil.	Nil.	Nil. re- duct. a.	Nil.	Nil.	Nil.	Nil
128	—	Almost insol.	Part. sol.	Sl. acid	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil
129	—	Sl.	44	Sl Alk.	Nil.	Yell. pp.	Nil.	Sl. wh. pp.	Sl. buff. pp.	Sl. yell. pp.	Red br. pp.
130	—	2½	13	Neut.	Nil.	Yell. pp.	Wh. pp. b. clot- ting. a.	Wh. pp.	Dirty yell. pp.	Yell pp.	Red br. pp.
131	—	Sl.Sol. cold m. hot	Sl.Sol. cold v. hot.	Ac.	Nil. b., buff. pp. a	Nil.	Nil.	Cryst. pp.	Nil.	Yell. Cryst pp.	Nil.
131a	—	Insol. al- most.	Sol. c. de- comp.	Ac.	Nil.	White pp.	Nil.	Deep red.	Nil.	Yell. pp. gr. fl.	Nil.
132	—	Pract insol.	140	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
133	—	Insol.	160	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
134	—	Sl.	3	Sl. alk.	Nil.	Sl. dark yell. pp.	Nil.	Very sl. wh. pp.	Very sl. dirty cream pp.	Sl. yell. pp.	Dark red br. pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal	M. Pt. (°C.)
135	Emetine Bismuth Iodide	Bl.	Alk. vap. colorless resid.	Bl.	Sol. Iodine evolved	Bl.	N .I .	—
136	Enesol (Hyd., ARSEN. SALICYL.)	Bl. c. metallic sub. & garlic odor.	Bl. & a grey deposit creeps up tube.	Nil.	Red br. eff. quickly darkens.	Nil.	Nil.	Nil
137	Ephedrine HCl.	M. & gives arom. odor, ch.	Alk. vap.	Eff. sl.	Eff. ch quick.	Nil.	N. & Cl.	211
138	Ergotinine ..	Bl. c. part fusion.	Floats as bl. mass on Soda & gives alk. vap.	Gr. br.	Gr. br. & ch. quickly.	Br.	N.	Blk at 210
139	Erythrol Nitrate.	M. & then ex- plodes.	Nil.	Nil.	Br. then wh. again does n't ch.	Nil.	N. This test must be used c. caution.	61
140	Ethyl-Mor- phine HCl.	M.c.eff. & gives fish odor. ch. vap. burns.	M. to br. sub- stance on sur- face of soda	Eff. sl.	Eff. br. tinge changing to faint blue ch slowly.	Eff. sl. & goes red. br.	N. & Cl.	124
141	Eucaïn Lactate.	M. & evaps., vap. burns.	Froths a lot, & vap. burns.	Nil.	Ch. quickly.	Nil.	N.	155
142	Eucalyptol ..	Evaps. vap. burns & euca- lyptus odor.	Sl. br., & vap. burns.	Br.	Red br. & ch. to a resino's solid	Nil.	Nil.	—

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
135	—	Insol.	Insol.	—	Nil.	Br.pp. sol. in excess	Nil.	Yell. pp.	Br. pp.	Yell. pp.	Br. pp.
136	—	Sl. sol.	Alm. insol.	Mod. ac.	Vi. col. b. & a.	Wh. pp.	Nil b. sl. opal. a.	Nil.	Nil.	Nil.	Sl. yell. pp.
137	—	7	8	Neut.	Nil.	Yell. pp rediss & repp. by exce's	Nil.	Nil.	Nil.	Nil.	Red br. pp.
138	—	Insol.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
139	—	Insol	Abo't 90	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
140	—	10	25	Neut.	Nil. b. sl. br. pp. a.	Yell. pp. rediss at first.	Light blue pp. b oily drops a.	Wh. pp.	Br. yell. pp	Yell pp	Br. pp.
141	—	5	8	Faint- ly alk.	Sl. cloud b., sl. br., pp. a.	Wh. pp.	W.h pp b. separ- ates as oily drops a.	Wh. pp.	Cr'm pp.	Yell pp.	Re br res- pp.
142	0.93	Sligh'y	Misc.	Neut.	Nil. b. sl. opal a.	V. sl. pp. rediss at first.	Nil.	Nil.	Nil.	Nil.	Br. pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	S O ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
143	Euresol ..	Bright red nr. edge of liq. Acetic odor, vap. burns & ch.	Yell. but if not thoroughly mixed patches of red.	Yell.-gr.	Olive gr. ch. slowly.	Br..	Nil.	—
144	Eurobin ..	M. & ch. vap blns.	Bl.	Red & turns to br.	Red sol. quick ch.	Br.	Nil.	Abt 94
145	Exalgine ..	M. & sub.	Benzol odor, vap. burns.	Nil.	Nil.	Nil.	N.	101
146	Fluorescein	Part m turns br. gr. ch. & swells up.	Vi. to bl. then yell.	Nil.	Yell. dissolves, turns red br.	Turns yell. immediately.	Nil.	—
147	Formalin ..	Boils, gives gas burns blue, sl. res. ch.	Goes br quick before heating. Vap. burns.	Forms glassy looking solid.	Ch.: quick	Ef. after a time, goes gr. at edges.	Nil.	—
148	Fuchsin ..	Part m. & br. vap. burns.	Separates fused on surf. of NaOH.	Red br.	Ch. quick.	Dark br.	N. & Cl.	—
149	Gelseminine	M. ch. br. dist. and alk vap. burns.	Floats on Na OH as br. mass.	Dkns. sl.	Red & ch. slowly.	Gr. col.	N.	158 160 Mer ck.
150	Glycosal ..	Sub.	Nil.	Nil.	Ch.	V. faint red-vi.	Nil.	63
151	Glycogen ..	Ch. br.-vell. vap. burns.	Br. c. alk. vap. burns.	Nil.	Ch. immed.	Nil	N. & S. (Impurities only).	—

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID FIC- RIO.	DRAG
143	1.200	Sl.	Misc.	Neut.	Br. vi. b. br. a.	Yell. pp. rediss at first	Nil b. gr. & then br. pp. a.	Nil.	Blu- ish. strks. come very sl'wly	Nil.	Red br. pp.
144	—	Pract insol.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil	Nil.	Nil.
145	—	60	Free- ly.	Alk.	Nil.	Wh. pp.	M. & floats. on top	Nil.	Nil.	Nil.	Br. pp.
146	—	Less than 1	2	Turns blue Litm. paper gr.-yl.	Br. pp. b Br. pp. a.	Or- ange. red pp.	Nil. col. b and a.	Bl.-	Yell. br. pp.	Yell. pp. rediss	Bl. pp. goes br.
147	1.08	Misc.	Misc.	Sl. ac.	Nil.	Nil.	Nil b. dark red pp. a.	Nil.	Nil.	Nil.	Nil.
148	—	Slight.	Abt. 20	Neut.	Nil.	Al- most bl. pp floats, liq. decol.	V. dark pp. b. and a.	Dark pp. pp. b. turns vi. pink.	Dark pp. sol. turns pur- ple.	Br. pp. sol. yell	Dark pp. sol. gr.
149	—	Sl.	Sol	Alk	Nil.	Yell. pp.	Nil. b. dirty gr. col. & sl. re- duct a.	Wh. pp.	Light br. pp.	Yell. pp.	Br. pp.
150	—	Sl.	3	Neut.	Deep vi.	Wh. pp.	Nil.	Nil.	Nil.	Nil.	Nil.
151	—	About 2 in- cmpte	Al- most insol.	Faint alk.	Nil. b. Sl pp. a	Sl. wh. pp.	Nil.	Nil.	Nil.	Yell pp.	Sl. red. br. pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
152	Guaiacol ..	Evap. c. char- act. odor vap. burns.	Br.	Sl. br.- yell.	Br. & ch.	Dk. br. c. violent re- action.	Nil.	—
153	Guaiacol Benzoas.	M. and evap., vap. burns.	Sl. br. c. vap. burns.	Yell.	Dark gr. and ch.	Nil.	Nil.	50 to 52
154	Guaiacol Carbonas.	M. & evaps. almost entirely vap. burns.	Br. up tube & vap. burns.	Nil.	Light gr. turns darker & ch.	Nil.	Nil.	86
155	Guaiacol Cinnamas	M. to clear liq. goes br. c. yell. sub. & vap. burns.	Yell. & gives peculiar odor. Vap. burns.	Orange col.	Orange to gr.- br. and ch.	Nil.	Nil.	130 Ha- ger).
156	Hexamethy- len-tetra- mine.	Sub. en- tirely S. m. or ch.	Wh. sub and sl. alk. vap.	Nil.	Ch. vap. burns.	Nil.	N.	—
157	Holocain HCl.	M. yell. ch., yell. dist. vap. bns. gr. fime.	M. br. liq. floats.	Sl. eff.	Diss' lvs c. sl. eff. ch. quick.	Nil.	N. Cl.	186- 189
158	Homatropine	M. col. less, then ch. br. dist. alk. vap. burns.	Eff. a lot, alk. vap. burns.	Nil.	Ch. quick.	Nil.	N'	98
159	Hydrastine ..	M. ch. alk. vap. burns.	Br. yell. & floats	Nil.	Deep plum col. ch.	Br.	N.	132
160	Hydrastinine HCl.	M. to yell. liq. ch. br. dist. vap. burns.	Br. c. eff. alk vap.	Eff. Yell.	Eff. yell. to deep red.	—	N. Cl.	6- 117

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
152	1.143	Sl.	Misc.	Neut.	Dk. br. b. Bl. pp. a.	Dk. orange pp.	Ni. b. sl. red pp. a.	Nil.	Nil. pp.	Nil.	Br. pp.
153	—	Almost insol.	50	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
154	—	Nil.	Abt. 200	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
155	—	Insol.	Sol.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
156	—	1	8	Alk.	Br. pp. b Red br. a.	Yell. pp.	Nil.	Nil.	Dirty yell	Cryst pp. after few secs.	Br. pp. t'ning bl.
157	—	55	8	Faint alk.	Nil.	Yell. pp.	Wh. pp. b a. clot- ting.	Wh. pp.	Buff. pp.	Yell pp.	Br. pp.
158	—	V. sl.	Abt. 3	Alk.	Nil.	Yell. pp.	Nil.	Wh. pp.	Buff. pp.	Nil.	Br.
159	—	V. sl	150	Neut.	Nil.	Sl. cloud	Nil.	Sl. cloud.	Nil.	Nil.	Sl. br pp.
160	—	Less than 1	Abt. 5	Neut.	Nil.	Yell. pp.	Nil. b. rd. pp. & gr. col. a.	Cr'am wh. pp.	Buff. pp.	Yell pp.	Red br. pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃	N. P. S. & Hal.	M. Pt. (°C)
161	Hyd. Succinas	Ch. and gives grey sub.	Bl.	Nil.	Sms. to ch. gets light c. wh. pp.	Dark'ns sl.	Nil.	—
162	Hyd. Succini- midum.	Ch. grey sub. vap. burns sl. cyanide odor.	Bl. c. strong alk. vap.	Nil.	Ch. fairly quick.	Dark'ns sl.	N.	Nil.
163	Hyd. Thymol- Acetas.	Ch. c. Acetic, then Thymol odor vap. burns.	Yell.s then bl., Thymol odor.	Nil.	Yell. then purple & ch.	Deep red br. after little time.	Nil.	Nil.
164	Hyoscyne HBr.	M. ch. br. dist. & alk. vap. burns.	Br. & floats on soda.	Eff. & sl. br.	Ch. quick.	Nil.	N., Br.	—
165	Hyoseyamine Sulph.	M. ch. & alk. vap. burns.	Br. floats on soda. Alk. vap.	Nil.	Ch. quick.	Nil.	N. & S.	206
166	Hypnal. ..	M. c. Chloral odor ch. & give alk. & inflam. vap.	Bl. & strong Isoni- trile odor.	Nil.	Eff. turns from yell. to br. not ch.	Nil. or slight Yell.	N. & Cl.	67 68
167	Indigo ..	Odor of HCN. Alk. vap. burns.	Br. c. alk. vap.	Nil.	Color- less & gives wh. pp.	Nil.	N.	—
168	Indigo-Car- mipe.	Gives off water, nothing else charac- teristic.	Dark brown.	Dis- solves to in- tense bl. sol.	Eff. sl. & dis- solves to blue sol. & c h.	Eff. sl. dissol- ves to yell. br. sol.	S. N.	—
169	Iodinol ..	I evolved	Sweet smelling vap.	Red sol.	Froth H.I.	Nil.	I	—

No.	SP. GR.	SOL. AQ. (1 in-.)	SOL. ALC. (1 in-.)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ERS.	GOLD CHL.	ACID PIC- RIC.	DRAG
161	—	V. sl.	V. sl.	Neut.	Nil.	Nil.	Nil.	Yell. pp. turns red.	Nil.	Nil.	Nil. pp.
162	—	28	V. sl.	Alk.	Nil.	Nil.	Sl. opal- esnce b. wh. pp. a.	Yell. pp. turns orange	Nil.	Nil.	Br. pp. turn- ing cre'm
163	—	Insol.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil
164	—	3	14	Neut.	Nil.	Yell. pp.	Nil.	Wh. pp.	Br. vell. pp.	Yel pp.	Red br. pp.
165	—	0.5	4	Neut.	Nil.	Yell. pp.	Nil.	Wh. pp.	Yell. pp.	Yell. pp.	Red nr. pp.
166	—	10	Abt. $\frac{1}{2}$	Neut	Deep red col. b., & a.	Yell. pp. re- diss. at first.	Nil. b. reduc- ed a	Sl. wh. cloud.	Buff pp.	Yel pp.	Br.
167	—	V. sl.	Insol.	Neut.	Nil	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
168	—	Sl.	Insol.	Neut.	Deep blue pp. pp br. a.	Dark gr. pp. dis- solv- ing to br. sol	Gr. cl. b. blue col & sl. rec pp. a	Deep blue pp.	Col. dis- char- ged sl'wly.	Nil,	Dark gr. pp.
169	10% 1.025 25% 1.23	Insol.	Insol.	Neut.	Nil.	Nil.	Nil.	—	—	—	—

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
170	Iohydrin ..	Br. c. oily dist. vi. vap. burns, & pungent res. ch.	Vap. burns, pungent odor & goes br.	Dark- ens sl.	Bl. gives vi. vap. & bl. metal- lic sub.	Nil.	I.	—
171	Lævulose ..	M. to br. liq. c. caram- el odor and ch. vap. burns.	Deep br. liq. vap. burns then nearly wh.	Goes br. slowly.	Ch. almost immedi- ately.	Nil.	Nil.	—
172	Lecithin ..	M. c. charac- teristic odor.	Wh. alk. vap.	Chars. slowly.	Car- bonises.	Nil.	N. (small q'tantity P.)	—
173	Luminal	Ac. vap. sm. of alc.	Alk. vap. fish odor.	Nil.	Ac. choking vap. ch.	Nil.	N.	173
174	Magnes. Ricinoleas <i>Syn.</i> MARICOL	Ch. and pungent vap. burns.	Sl. arom. oily odour.	Sl. eff.	Eff. ch. quickly.	Sl. Eff.	Nil.	—
175	Malachite Green.	Part m. goes gr. up tube & then br. vap. burns.	Goes br. and then wh.	Turns red- dish	Eff. sl. and ch. quick.	Turns red colour.	N. & Cl.	—
176	Malourea ..	M. & sub.en. tirely vap. burns.	Alk. vap. & pecu- liar odor.	Nil.	Ch. slowly.	Nil.	N.	191

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
177	Mannitol Nitrate.	M. goes br. and expldes	Br. gives minute flashes of light then goes almost wh.	Nil.	Yell. does not ch.	Nil.	N.C. difficulty.	113
178	Medinal ...	Alk. vap. alc. & ammon odor.	As 1st column.	Nil.	Ch. SO ₂	Nil.	N.	—
179	Methyl-Amino Oxybenzoas	M. to Yell. liq. ch. br. dist. & alk. vap.	Goes vi, then gr. c. sl. alk. vap.	Nil.	Br. & ch. slowly.	Blue bl. changing to red-br.	N.	141
180	Methyl-Atropin Nitras.	M. eff. ch. & br. dist., & alk. vap. burns.	Br., & gives inflam. alk. vap.	Nil.	Br., & turns purplsh.	Nil.	N.	149-150
181	Methyl-Di-Tannin.	Ch. c. br. dist. & Tannin odor.	Br. then orange then red-br.	Nil.	Int'nsly blue, then ch.	Br. c. sl. eff.	Nil.	—
182	Methylene Blue.	Swells and ch. c. sulphur odor.	M. and floats on surf. of soda & colors top of tube vi.	Sl. eff. and dark gr.	Eff. a lot and ch. quick.	V. dark green.	N.S. & Cl.	—
183	Migralgin ..	M. then ch. and gives br. alk. vap. burns.	M. on surf. of soda tns red br. Magnta up sides of tube alk. vap.	Nil.	Yell. does not ch.	Nil.	N.	101-105
184	Morphine HCl.	Ch. c. br. dist.	Orange br. c. alk vap. burns.	Sl. eff.	Ch. quick.	Red c. sl. eff. & changes to yell.	N. & Cl.	—

No.	SP. GR.	SOL. AQ. (1 in-)	SOL. ALC. (1 in-)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
177	—	Almo't insol.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
178	—	5	Alm'st insol.	Alk.	Buff pp.	Decol.	Nil.	Nil.	Nil.	Nil.	Buff pp.
179	—	V. sl.	7	Neut.	Vi. br col. b., gr. br. pp. a.	Dirty gr. br. pp.	Nil. b., br. red pp. a.	Nil.	Dark gr. pp.	Nil.	V. sl. red br. pp. slow- ly.
180	—	1	4	Neut.	Nil.	Wh. pp.	Nil.	Wh. pp.	Cr'am pp.	Nil.	Dull red pp.
181	—	Sl.	About 3	Neut.	Bl. col. b br. pp. a.	Nil.	Nil.	Nil.	Vi. col.	Nil.	Nil.
182	—	About 6	Sl.	In- d'finte	Vi. blue b., navy blue a.	Bl. pp. and sol. almost color- less.	Nil. b. bl. pp. a.	Co- pious blue pp.	Bl. s pp.	Red bl. pp.	Co- pious bl. pp.
183	—	0.8	1	Prac. neut.	Deep red br. b., and a	Yell. pp. re-dis- solving.	Nil.	Wh. pp.	Dull. yell. pp.	Brght yell pp.	Orng red pp
184	—	24	About 55	Neut.	Blue br. b. yell. a.	Yell. pp. rediss at first.	Nil.	Yell. wh. Gelat inous pp.	Yell. br. pp. turns dark'r	Yell pp.	Red. br. pp.

NO	SUBSTANCE.	HEAT	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
185	Naphthol Bismuth.	Goes bl. c. red br. sub.	Goes bl.	Dark br.	Goes inky bl. c. wh. pp.	Goes bl.	Nil.	Nil.
186	Nicotine ..	Evaps. c. naus odor.	Charac- teristic choking Nicot. odor.	Light red	Red then carbon- ises.	Nil at first but pinkish later.	N.	—
187	Nitrobenzene	Dist. ch. sl vap. burns	Goes br. vap. burns.	Nil.	Ch. slowly	Nil.	N.	—
188	Novocain ..	M. to clear liq. ch. c. alk. vap. and naus. odor.	Br. to gr. yell. and gives alk. vap.	Eff.	Eff. and goes sl. yell. does not ch.	Nil.	N. Cl.	150
189	Nuclein ..	Ch. br. alk. vap. burns.	Red-nr. eff. a lot alk. vap.	Almost bl. gummy mass.	Ch. at once	Br. gummy mass.	N. & P.	Nil.
190	Orexin TANNAS.	Ch. part m. & gives br. dist. sl. alk. vap. burns.	Goes yell.	Goes a dirty gr. br.	Deep vi & then ch. quick.	Turns red br. & eff. sl.	N.	Nil.
190a	Papaverine	Alk fishy vap.	Alk vap. Pyridine odor.	Yell.	Ch. SO ₂	Yell	N.	147
191	Paraform ..	Part m. and sub. vap. burns.	Br. and vap. burns.	Nil.	Ch. slowly vap. burns.	Eff. violent- ly after a while.	Nil.	171
192	Paraldehyde	Evaps vap. burns.	Vap. burns.	Nil.	Ch. almost immed.	Nil.	Nil.	10- 12
193	Pelletierine (SOLID).	M. ch. and alk. vap. burns.	Floats as br. liq. on surface, vap. burns.	Nil.	Goes br. and ch. slowly.	Nil.	N.	46

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₃ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD OHL.	ACID PIC- RIC.	DRAG
185	—	V. sl.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
186	—	Misc.	Misc.	Alk.	Br. pp. b. darker pp. a.	Yell. pp. rediss at first.	Nil.	Wh. pp.	Buff pp.	Yell. pp.	Br. pp.
187	1.204	Sl.	1	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Light br. pp.
188	—	Less than 1	10	Neut.	Nil.	Yell. pp. rediss finally wh. pp.	Pale blue pp. b., oily drops a.	Wh. pp.	Br. pp.	Yell. pp.	Red- br. pp
189	—	V. sl.	Insol.	Sl. ac	Nil. b. froth- iness a.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
190	—	Sl.	55	Neut.	Dark gr. tinge b., sl. br. pp. a.	Yell. pp.	Blu- ish op'les cence b. Nil. a.	Wh. pp.	Dark buff pp.	Yell. pp.	Red br. pp.
190a	—	Sl. Sol. hot insolc.	Sl. sol. hot V. Sl. c.	Neut.	Nil.	Yell. pp.	Nil.	Wh. pp.	Buff pp.	Yell pp.	Br. pp.
191	—	V. sl.	Sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
192	0.988	10	Misc.	Sl. acid.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
193	—	4	3	Alk.	Br. pp. b and a.	Wh. pp.	Nil.	Nil.	Nil.	Yell. pp.	V. dark br. pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt (°C.)
194	Petrol Ether	Evaps. vap. burns.	Vap. burns.	Nil.	Ch. slow vap. burns.	Nil.	Nil.	—
195	Phenacetin ..	M. and volatil- ises almost com- pletely vap. burns.	Br. vap. burns.	Nil.	Ch. fairly quick.	Red br. col.	N.	135
196	Phenalgine ..	Part m and eff. dense sub. ch. alk. vap. burns.	Strong alk. vap. burns.	Eff. strong	Goes dark no ch.	Eff. strong.	N.	—
197	Phenazone ..	M. then ch. and br. alk. vap. burns.	Red br. & goes red vi. up tube and alk. vap. burns.	Nil.	Yell. no ch.	Nil.	N.	113
198	Phenazoni Aceto- Salicylas.	M. Ace- tic then Phenol- ic inflam. vap.	Red col. creeps up tube.	Nil.	Ch. v. slowly.	Br. v. slowly.	N.	Abt 45°
199	Phenazoni Salicylas.	M. to clear liq. ch. br. dist. and sl. alk. vap. burns.	Mag'nta sub. then br. alk. vap. & ch.	Darkens v. sl.	Br. and chars sl.	Darkens v. sl.	N.	90
200	Phenocoll HCl.	Part m. and ch. br. sub. alk. vap. burns.	M. to br. liq. on soda.	Eff. sl.	First br. then color- less and ch.	Bright yell.	N. Cl.	—
201	„ Salicyl	M. to br. liq. ch. alk. vap. burns.	M. to br. liq. on soda.	Nil.	First br then colorless then br. and ch.	Red br eff.	N.	160- 165c dec- omp

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fr ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
194	0.670 to 0.700	Insol.	4	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
195	—	Sl.	20	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
196	—	Part.	Part.	Alk.	Br. pp. b dark- ening a.	Wh. pp. and eff.	Nil.	Nil.	Sl. dark pp.	Bil.	Nil.
197	—	1 $\frac{1}{4}$	1	Neut.	Deep red b. and a.	Yell. pp. re- diss.	Nil.	Nil.	Buff. pp.	Yell. pp.	Red br.pp
198	—	160	3 $\frac{1}{2}$	Ac.	Deep vi. b. & a.	Wh. pp.	Nil.	Wh. pp.	Yell. pp.	Nil	Red pp.
199	—	200	4 $\frac{1}{2}$	Acid	Vi. col. b. and a.	Wh. pp.	Nil.	Wh. pp.	Sl. buff. pp.	V. sl. yell. pp.	Red br. pp.
200	—	18	34	Neut.	Nil.	Yell. pp. re- diss. first.	Vi. col. b. vi. br pp. a.	Wh. pp.	Nil.	Yell. pp. turns cryst	Br. red pp.
201	—	Sl.	50	Neut.	Vi. col. b., & a.	Wh. pp.	Nil. b. sl. vi. br. pp. a.	Nil.	Nil.	Yell. crysts form slwly	Br. red pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pts. (°C)
202	Phenolph- thalein.	M. to br. liq. ch. Phen- ol odor.	Bl. then deep purple to orange	Deep red	Red to br. ch. slowly.	Yell.	Nil.	250
202a	Phenoquin ...	Ch. Choking vap.	Alk. vap. burnt feathers.	Yell.	Ch. SO ₂	Yell.	N.	—
203	Phloridzin ..	M. c. sl. eff. ch. and gives br dist. and vap. burns.	Yell. then br. finally grey c. much eff.	Yell.	Red br. and ch. quick.	Bl. to red-br.	Nil.	107 re- sld fies & m agn. at 170
204	Physostig- mine.	M. gives v irritat- ing vap. ch. alk. vap. burns.	Br. & alk. vap.	Sl. yell	Br. yell changes to gr. & ch.	Yell.	N.	75
205	Physostig- mine Sulph.	M. gives irritat- ing inflam. & alk. vap.	Br. & gives alk. vap.	Sl. yell.	Br. yell. turns gr. & chars.	Yell.	N S.	140
206	Phytin ..	Ch. br. dist.	Orange red, then gr. Vap. burns.	Nil.	Orange. pink then br. & ch.	Nil.	P.	Nil
207	Picrotoxin ..	M. ch. br. dist. vap. burns.	Orange yell. to br. c. inflam. gas.	Orange yell.	Orange yell. to deep red-br. & ch.	Nil.	Nil.	192
208	Pilocarpine	Boils, ch. & alk. Vap. burns.	Floats as oily liq. on soda.	Nil.	Ch. slowly.	Nil.	N.	—
209	Pilocarpine Nitrate.	Ch. alk. Vap.	Floats as oily liq. on soda.	Nil.	Ch. slowly.	Nil.	N.	—

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S	GOLD CHL.	ACID PIC- RIC.	DRAG
202	—	V. sl.	10	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
202a	—	Insol.	Sl. sol.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Br. pp.
203	—	V. sl.	4½	Neut.	Vi. br. b. br. col. a.	Sl. yell. pp.	Nil.	Nil.	Nil.	Nil.	Nil.
204	—	Sl.	2	Alk.	Nil.	Yell. pp.	Nil. b., br col. & red pp. a.	Wh pp	Br. pp. and pur- plish sol.	Yell. pp.	Red pp.
205	—	Less than 1.	Less than 2.	Faint alk.	Br. col. b., decol- orises & light br. pp. a.	Yell. pp. rediss at first	Nil. b., br. col. & red pp. a.	Wh. pp.	Fawn pp. turn- ing to bl. c. purple sol.	Yell. pp.	Red br. pp. turn- ing or 'ng
206	—	Less than 1 but throws out on dilut- ing.	Insol.	Acid	Wh. pp. b., & a.	Nil.	Gela- tinous pp. b., almst. rediss Th'wn out agn a. Nil. b. sl. pp. a.	Nil.	Nil.	Nil.	Sl. Yell. pp.
207	—	Sl.	13	Neut.	Nil.	Nil.	Nil. b. sl. pp. a.	Nil.	Nil.	Nil.	Nil.
208	—	V. easily.	Misc.	Alk.	Sl. cloud b., nil. a.	Pale yell. pp. rediss. at first.	Nil.	Wh. pp.	Crmy yell. pp.	Sl. yell pp.	Br. red pp.
209	—	9	50	Neut.	Nil.	pp. re- diss. at first.	Nil.	Wh. pp.	Crmy yell. pp.	Yell. pp.	Br. red pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ ,	E. P. S. & Hal.	M. Pt. (°C)
210	Piperazin ..	M. & evaps. completely & alk. vap. burns.	Cryst sub. & alk. vap. burns.	Com- bines c. hiss- ing noise.	Nil.	Nil.	N.	104 107
211	Piperazin Benz.	M. & evaps. vap. burns.	Sl. alk. vap.	Nil.	Dark- ens sl.	Nil.	N.	abt. 167
212	Piperidine Tart.	M. ch. wh. then yell. vap. c. celery odor.	Alk. vap.	Nil.	Ch.	Nil.	N.	Abt 80
213	Podophyllo- toxin.	Part m ch. br. dist. and vap. burns.	Yell. br.	Br. mass gr-yell. on edges.	Br. yell. to deep br. and ch.	Eff. and goes choc. br.	Nil.	—
213a	Proflavine ...	Alk. vap. H ₂ S.	Yell. sub. alk. vap.	Eff. H ₂ S.	Ch. SO ₂ .	Nil.	N.S.	—
214	Propional ...	Distils	Alk. vap. odor of NH ₃ and propyl alc.	Nil.	Ch. SO ₂ .	Nil.	N.	145
215	Pyramiden ..	M. ch. & alk. vap. burns c. isonit-rile odor.	Goes br and gives strong isonit. odor.	Nil.	Light r. not char.	Eff. and goes br.	N.	—
216	Quinine ..	M. ch. c. br. dist. & alk. vap. burns.	Orange to gr. yell., & floats as br. mass.	Nil.	Yell. & ch. slowly.	Strong fluores- cence.	N.	172
217	Quinine Sulphate	M. to red liq. ch. c. vi. then br vap.	Orange to gr. yell.	Nil.	Yell. & ch. slowly.	Strong fluores- cence.	N.S.	205 wh. dr'd

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₃ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S	GOLD CHL.	ACID PICO- RIC.	DRAG
210	—	2	3	Alk.	Red br. pp. b & a.	Yell. pp. re- diss. at first.	Nil.	Sl. wh. pp.	Red br. pp.	Sl. yell. pp.	Bl. pp. turn- ing yell.
211	—	100	10	Acid.	Buff pp. b. & a	pp. diss. at first.	Nil.	Nil.	V. sl. buff. pp.	Yell. pp.	Red br. pp.
212	—	Less than 1.	About 30	Acid.	Nil.	Yell. pp.	Nil. b. re- duc- tion slow- ly a.	Wh. crysts form slow- ly.	Nil.	Nil.	Br. pp.
213	—	V. sl.	Misc.	Neut.	Nil.	Nil.	Nil		Nil.	Nil.	Nil.
213a	—	140	48	Neut.	Nil.	Buff pp.	r. pp. b. sol. a.	ange pp.	Deep gr. fluor.	Or- ange pp.	Br. pp.
214	—	Insol.	Sl. sol.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
215	—	20	2	Alk.	Vi. col disap- pear- ing b., br. pp. a.	Vi. col.	Nil.	Wh. pp.	Vi. col.	Yell. pp. rediss	Br. pp.
216	—	V. sl.	1	Sl. alk.	Nil.	Yell. pp.	Wh. pp. b Nil. a.	Wh. pp.	Cre'm pp.	Yell. pp.	Br. red pp.
217	—	800	100	Neut.	Nil. b. br. pp. a.	Yell. pp. rediss first.	Wh. pp. b Nil. a.	Wh. pp.	Cre'm pp.	Yell. pp.	Br red pp

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ . Cold.	H ₂ SO ₄ . Hot.	HNO ₃ .	N.P.S. & Hal.	M. Pt. (°C.)
218	Resorcin ..	M & sub. vap. burns, c. sweet odor.	Red br. and changes to dirty white.	Yell. gr.	Gr. & ch. quick c. much spirt'ng.	Yell. to br. slowly.	Nil.	110 C.
219	Saccharin ..	M. to clear liq. ch. wh. cryst. sub. & vap. burns c. arom. odor.	Alk. vap. eff. consid.	Nil.	Darkens sl. no ch.	Nil.	N.S.	220
220	Salacetol ..	M. and ch. vap burns.	Orange col. then fades into muddy col.	Pinkish after a while.	Red vi. and chars. quick.	Nil.	Nil.	67
221	Salicin ..	M. then ch. c. caramel odor.	Br. caramel odor vap. burns.	Red col.	Ch.	Nil.	Nil.	198 201
222	Salicyl- Salicylas.	M. & gives wh. sub ch. & gives Phenol odor & vap. burns.	Floats as insol. powder on sur- face of soda.	Nil.	Goes br does not ch.	Nil.	Nil.	142
223	Sal Limonis	Ch. and sl. vap. burns.	Greyish and froths a lot.	Nil.	Ch. quick. vap. burns.	Nil.	Nil.	--
224	Salocoll vide PHENOCOLL SALICYL.	—	—	—	—	—	—	—
225	Salol ..	M. boils then ch. vap. burns c. Phenol odor.	Turns yell.	Yell.	Ch. slowly.	Nil.	Nil.	43

[illegible]

No.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
226	Saloquinine	M. ch. alk. vap. burns.	Yell. then br	Nil.	Ch. fairly quick.	Nil.	N.	139
	Salvarsan (see ARSENO- BENZOLE)	—	—	—	—	—	—	—
227	Santalol ..	Evaps. vap. burns c. characteristic odor	Yell. br. vap. burns.	Deep red. br.	Deep red br. and chars. quick.	Sl. br.	Nil.	—
228	Santalol Salicylas.	Part evaps. c. characteristic odor, vap. burns, res. ch.	Yell. br and vap. burns.	Red br.	Red br. ch. quick.	Sl. dark	Nil.	—
229	Santonin ..	M. to clear liq. ch. gives br. dist.	Red then br. vap. burns.	Nil.	Yell. to br. and ch.	Nil.	Nil.	170
230	Sodium Anhydro- Methylene- Citrate.	Ch.	Nil.	Nil.	Ch.	Nil.	Nil.	Sft- ens 82 & ch 250
231	Sodii Cacodyl.	Part m bl. metallic sub., inflam. gas, c. garlic odor.	Eff. a lot.	Nil.	Nil.	Nil.	Nil.	—
232	„ Glyceroph	Ch. and irrit. vap. burns.	Dark- ens sl. inflam. gas.	Eff. sl.	Ch. quick.	Eff. sl.	P.	—
233	„ p-amino- phenyl Arsonas (see 73).	—	—	—	—	—	—	—
222	„ Salicyl ..	Ch. c. odor of Phenol.	Nil.	.. Nil.	Goes dark, does not ch	Nil.	Nil.	—

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
226	—	V. sl.	120	Neut.	Nil.	Nil.	Nil.	Sl. opal- esce.	Nil.	Nil.	Sl.br. pp.
—	—	—	—	—	—	—	—	—	—	—	—
227	—	Pract. insol.	Misc.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
228	1.012	Pract. insol	Abt. 40.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
229	—	Sl.	40	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
230	—	1	Sl.	Faint Acid.	Br. pp. b.	Yell. pp.	Nil.	Nil.	Yell. pp.	Nil.	Br. pp.
231	—	0.5	1	Alk.	Nil.	Nil.	Nil.	Nil.	Sl. buff pp.	Nil.	Red br. pp.
232	—	0.33 slowly	Sl.	Alk.	Dark buff pp. b. & a.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
233	—	—	—	—	—	—	—	—	—	—	—
234	—	0.83	5½	Sl. ac	Vi.col b., vi. pp. a	Wh. pp.	Nil.	Nil.	Nil.	Nil.	Nil.

No.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
235	Sodii Sulphocarb	Decrep- itates, ch. vap. burns c. Phenol odor.	Nil.	Nil.	Ch. slowly.	Nil. at first, turns red slowly.	S.	—
236	„ Sulphori- cinas	Evaps. ch. & vap. burns.	Eff. a lot and soapy. odor.	Br. col.	Deep red and ch.	Vi. br.	S. (Cl. impur- ity).	—
237	„ Taurocho- las.	Part m., swells up and alk. vap. burns.	Br. & gives alk. vap.	Nil.	Red c. green fluores- cence, and ch. quick.	Nil.	N.S.	—
238	Sparteine Sulph.	M. boils ch. Pyr- idinic odor. alk. vap. burns.	Alk. vap. & mousy odor.	Nil	Nil.	Ni..	N.S.	Fir st abt. 62 & ag. 140
239	Stovaine ..	M. vola- tilises ch. c. odor of varnish.	Wh. fumes amylic odor.	Eff. no color.	Diss. & ch. on boiling.	Nil.	N. & Cl.	168
240	Strophanthin	Swells ch. c. br. dist. vap. burns.	Pinkish then br. vap. burns.	Em. gr chang- ing to br.	Ch. al- most at once.	Br.	Nil.	Be- gins to fuse at 170 m. at 190 com plt- ly
241	Strychnine	M. to br. liq. & alk. vap. burns	Bright red & floats on surface.	Nil.	Ch. slowly.	Nil.	N.	268

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD OHL.	ACID PRO- RIC.	DRAG
235	—	5	150	Neut.	Vi.col. b., br.col. & pp. a.	De- color- ised	Nil.	Nil.	Nil.	Nil.	Nil.
236	—	Misc.	Misc.	Alk.	Buff. pp. br. turns br. & m. a.	Yell. pp.	Nil. b. froths a.	Nil.	Nil.	Nil.	Yell. br. pp.
237	—	0.5	About 2	Alk.	Mud. gela- tinous pp. b. br. a.	Res- inous grey- ish pp.	Gr. col. b red pp. slow- ly a.	Nil.	Nil.	Nil.	Br. resi- nous. pp.
238	—	Less than 0.5	6	Ac.	Nil. b. Lt. br. pp. a.	Yell. pp. redis. at first.	Wh. pp. b., red- oily drops a.	Wh. pp.	Buff. pp.	Yell. pp.	Red br. pp.
239	—	13	3	Pract. neut	Nil.	Yell. pp.	Re- duces on boil- ing.	Wh. pp.	Yell. pp.	Yell. pp.	Buff pp.
240	—	Less than 1	Aht. 1.	Neut.	Nil. b. lt. br. pp. a.	Nil.	Nil. b. red br. pp. a.	Nil.	Nil.	Nil.	Nil.
241	—	V.sl.	150	Neut.	Nil.	Yell. pp.	Nil.	Wh. pp.	Buff. pp.	Yell. pp.	Nil.

NO	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃	N. P. S. & Hal.	M Pt (°C.)
242	Sucrose(CANE SUGAR).	M. to yell. liq. c. charac- teristic odor, ch. & vap. burns.	Br. & vap. burns.	S. yell. slowly.	Ch, almost at once.	Nil.	Nil.	160
243	Sulphonal ..	M. to wh. liq. c. a. pp. in it. Ch. gives cryst. sub. vap. burns c. sl. garlic odor.	Dark- ens sl. gives inflam. gas & sl. garlic odor.	Nil.	Red-br & ch. quick.	Nil.	S.	126
244	Terpineol (DISTILLATE FROM TERPINOL).	Evaps. ent'r'ly, vap. burns.	Vap. burns.	Red-br.	Ch. v. quick.	Orange pink.	Nil.	—
245	Terpin Hydrate.	M. evaps. c. in- flam. vap. & wh. cryst. sub.	Vap. burns.	Yell. br.	Yell.to orange red & ch.	Orange pink.	Nil.	116
246	Tetra-Iodo- Pyrrol.	Bl. & gives bl. sub. & vi. vap.	Alk. vap. goes gr.-grey to br.	Gr. Dark- ening slowly.	Light gr., turns dark then bl. c. vi. vap. & metal- lic sub.	Red br. slowly.	I.N.	—
247	Theobromine	M. to colorl'ss liq. sub. res. ch. c. alk. vap.	Bl. sl. c. strong alk. vap.	Nil.	Yell. but does not change.	Nil.	N.	Abt 300

NO.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin —)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil	BR. AQ.	FEH- LING'S b. & a. boil	MAY ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
242	—	Less than 0.5	Abt. 120	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
243	—	Sl.	50	Neut	Nil.	Nil.	Nil.	Nil.	Nil	Nil	Nil.
244	0.944	Sl.	Misc.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Br. pp.
245	—	Sl.	14	Neut.	Nil	Nil.	Nil.	Nil	Nil.	Nil.	Nil.
246	—	V. sl.	21	Neut.	Nil.	Nil.	Nil. b. sl. red pp. a.	Nil	Nil.	Nil.	V. sl.
247	—	V. sl.	Sl.	Neut.	Nil	Nil.	Nil. b. v. sl. br. pp. a.	Nil.	Nil	Nil.	Sl. red br. pp.

NO.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
248	Theobromine Aceto Salicyl.	M. c. eff to br. liq. wh. sub. acetous ch. and vap. burns.	Darkens sl. alk vap. burns.	Nil.	Dark red br., no ch. Benzoic and Acetic odor.	Nil	N.	—
249	Theobromine Sodium Acetate.	Part m. & sl. wh. sub. ch. alk. vap.	Alk. vap.	Eff	Yell. does not ch.	Eff.	N.	—
250	Theobromin- Sod.-Salicyl.	Ch. Phenol odor, wh. dist. & alk vap. burns.	Eff. str alk. vap.	Nil.	Br. slowly, does not ch.	Nil	N.	Nil.
251	Theophylline	M. to yell. liq sub. res ch. and gives alk. vap.	Bl. sl. and alk vap. burns.	Nil.	Yell. does not ch.	Nil.	N.	266
252	Theophylline Sodium Acetate.	Part m. and ch. alk. vap. burns.	Alk. vap. burns.	Nil.	Yell. does not change.	Nil.	N.	—
253	Thioresorcin	Ch. yell. sub. & vap. burns.	Gr. then orange yell.	Gr. grey.	Dirty gr. & ch.	Eff. & goes dark br.	S.	—
254	Thiosinamin	M. to colorless liq. pun- gent garlic odor ch alk. vap. burns.	Salmon col. chang- ing to yell. alk. vap. burns.	Nil.	Yell. to red-br. & ch.	Nil.	N. & S	74

NO.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil	BR. A Q.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
248	—	Sl.	Sl.	Sl. ac.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil
249	—		Sl.	Alk.	Lt. br. br. pp. b. & a.	Nil.	Nil.	Nil	Nil.	Nil.	Yeli br.pp
250	—	2 (c.f. Vol.I.)	V. sl.	Str. alk.	Vi. col. b vi. pp. a.	Wh. pp. rediss at first.	Nil.	Nil.	Br. color & v. sl. pp.	Nil	Deep br.pp. turn. ing light- er.
251	—	Sl	90	Neut	Nil.	Cryst pp. v slow- ly. Nil first.	Nil.	Nil.	Nil.	Nil.	Br.bl pp.
252	—	20	Sl.	Str'ng alk.	Light br. pp. b. dark bl. pp a.	Nil., red-br c. excess of Re- agent	Nil. b. and a	Nil.	Vr. col.	Nil.	Dark br.pp
253	—	V. sl.	V. sl.	Acid	Nil. b. sl. br.. pp. a.	Nil.	Nil. b. sl. vi. br pp a.	Nil.	Nil.	Nil.	Nil.
254	—	18	2	Neut.	Red col. b., br. pp. a.	Yell pp. rediss and giving wh. opal- es- cence.	Light blue pp. b., bl. pp. a	Wh. pp.	Buff pp. rediss	Nil a' first sl. pp a	Or. yell pp.

No.	SUBSTANCE.	HEAT.	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M. Pt. (°C.)
255	Thymol ..	M. evaps entirely aroma- tic vap. burns.	Pun- gent charac- teristic odor.	Nil.	Ch. slowly.	Eff. & gives reddish oil.	Nil.	44
256	Thymol Iodide.	M. to br. c. vi- br. vap burns.	Goes bl.	Nil.	Vi. vap. & vl. sub.	Dark'ns	I.	Nil.
257	Tiodin ..	Ch. alk. vap. burns c. garlic odor.	Eff. a lot, goes salmon pink and alk. vap. burns.	Br. bl.	Pinkish vi. c. vi. vap. br. dist. and garlic	B. bl.	N.S.I.	—
258	Toluol ..	Evaps. entirely vap. burns.	Vap. burns.	Nil.	Br. and ch.	Nil.	Nil.	—
259	Tribrom- phenol.	M. ch. gives wh. sub. and irritat- ing vap.	Ch.	Nil.	First m. and then ch. & c. br. irritat- ing vap.	Br. after a time.	Br.	85
260	Tribrom- phenol Bismuth.	Bl. and gives yell. sub. first & br. a.	Bl.	Turns grey.	First bl. and then br.	Red-br. c. sl. eff.	Br.	—
261	Tropacocaine HCl.	M. ch. br. sub. half way up tube.	Wh. vap.	Eff. with- out ch.	Wh. fumes and ch.	Nil.	NCl.	—
262	Tylmarin ..	M. ch. c. charact- eristic odor vap. burns.	Yell. c. eff. then color- less.	Gr. Yell.	Ch.	Yell.	Nil.	152

No.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₃ b. & a. boil.	BR. AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
255	—	1.500	0.375	Yell. pp.	Nil.	Wh. pp.	Nil.	Nil.	Nil.	Nil.	Nil.
256	—	Insol.	V.sl.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
257	—	Easily	Misc.	Neut.	Nil. b. sl. pp. a.	Br. pp.	Pale blue pp. b cream pp. a.	Wh. pp.	Br. bl pp.	Yell. pp. at first rediss.	Red br. pp.
258	—	V. sl.	1	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
259	—	Insol.	3	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
260	—	Insol.	Insol.	Neut.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
261	—	2	About 9	Neut.	Red tinge.	Yell. pp.	Nil.	Wh. pp.	Yell. pp.	Yell. pp.	Red br. pp.
262	—	Sl.	15	Sl. ac	Nil.	Sl. cloud.	Nil.	Nil.	Nil.	Nil.	Nil.

No.	SUBSTANCE.	HEAT	HEAT c. NaOH.	H ₂ SO ₄ Cold.	H ₂ SO ₄ Hot.	HNO ₃ .	N. P. S. & Hal.	M Pt. (°C.)
263	Urea ..	M. gives wh. sub. & alk. vap. Res. goes solid & yell. then sub. en- tirely.	Strong alk. vap.	Nil.	Brisk eff. no col.	Nil.	N.	132
264	Urethane ..	M. evaps. vap. burns.	Alk. vap. burns.	Nil.	Dark br. not ch.	Nil.	N.	48
265	Veratrina ..	M. to yell. br. liq. br. dist. vap. burns.	Br. & floats on soda	Yell. to red slow.	Deep red & ch.	Pink to br.	N.	152
	Veronal, <i>see</i> Malo-Urea.							
266	Zinc Sulpho- Carb.	Ch. c. odor of Phenol. vap. burns.	Lique- fies.	Nil.	Ch. slowly.	Br after a time.	S.	—

NO.	SP. GR.	SOL. AQ. (lin—)	SOL. ALC. (lin—)	LIT- MUS.	Fe ₂ Cl ₆ b. & a. boil.	BR AQ.	FEH- LING'S b. & a. boil.	MAY- ER'S.	GOLD CHL.	ACID PIC- RIC.	DRAG
263	—	1	7½	Neut.	Nil.	Nil	Nil. b. sl. red pp. a.	Nil.	Nil.	Nil.	Nil.
264	—	2	Less than 1.	Neut.	Grey br. pp b., dark br. pp. a.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
265	—	V. sl.	3	V. faint. alk.	Nil.	Yell pp.	Nil.	V. sl. wh. pp.	Sl. cloud	Nil.	Red br. pp.
266	—	2	3½	Sl. ac	Vil col. b br. a.	De- color- ised.	Wh. pp. re- diss- b. nil a.	Nil.	Nil.	Nil	Nil.

CORROBORATIVE TESTS.

1. **Acetanilide.**—Heated with Hydrochloric Acid or Potash Solution splits up into Aniline and Acetic Acid. Heated with Chloroform and Potash gives Phenyl-isocyanide odour.

0.1 Gm. boiled with HCl 2 Cc. then mixed with 3 Cc. of Aqueous Phenol Solution (1 in 20) and 5 Cc. of filtered saturated Chlorinated Lime Solution, acquires brownish red color which changes to deep blue on adding Ammonia (Indophenol test U.S.P.).

Heated with Boric Acid over a naked flame, produces a yellow residue having a peculiar fragrant odour suggestive of sweet clover. Phenacetin will, under same conditions, produce the yellow color—Phenazone produces a pink color and odour of Naphthalene.

2. **Acetone.**—Oxidation with Bichromate and Sulphuric Acid gives Acetic and Formic Acids. Combines with Chloroform in presence of Caustic Alkali to form Acetone-Chloroform :

$(\text{CH}_3)_2\text{C} \begin{smallmatrix} \diagup \text{OH} \\ \diagdown \text{CCl}_3 \end{smallmatrix}$, colorless crystals M.Pt. 96°C . insoluble in water. In aqueous solution can be thrown out by Salts, e.g., Calcium Chloride. For detection of small quantities, e.g., in urine by Iodoform Test, v. Urine Examn.

3. **Acetophenone.**—With Hydroxylamin forms Acetoxim $\text{C}_6\text{H}_5\text{C}(\text{N.OH}).\text{CH}_3$ Colorless needles M.Pt. 59°C . This by action of Sulphuric Acid or Hydrochloric Acid in Glacial Acetic Acid solution is converted into Acetanilide (Beckmann's reaction).

5. **Acetyl-*p*-Amido-Salol.**—Yields Salicylic Acid on hydrolysis c. NaOH. Is not hydrolised by HCl. Does not give Isonitrile test, but on adding the chloroform it gives a brownish red colour.

When hydrolysing with dilute NaOH it turns blue, the colour changing to reddish violet on boiling, the blue reappearing on cooling is changed to red with HCl.

7. **Acid. Acetyl-*o*-Coumaric**, see "Tylmarin."

8. **Acid. Agaric.**—Turns gelatinous and soapy on boiling with water and gives Pettenköfer's test, c.f., Sodium Taurocholate.

11. **Acid. Carbol. Cryst.**—Turns brown with $\text{NaNO}_2 + \text{HCl}$ and reddish brown on adding NaOH.

12. **Acid. Cholalic.**—Gives blue unstable compounds with Iodine resembling Starch Iodide.—Watts *q.v.* for further full information.

13. **Acid. Cinnamic.**—Oxidised with Potassium Permanganate to Benzaldehyde. Can be reduced by Sodium Amalgam to Hydrocinnamic Acid (β .phenyl-propionic Acid).

May be detected in presence of Benzoic Acid by suspending in 5% Uranium Acetate solution and exposing to sunlight,—in a few minutes odour of Benzaldehyde is evolved, and brown precipitate forms.—Allen.

15. Acid. Coumaric.—Melted with KOH gives Salicylate and Acetate. Aqueous solutions of Alkaline Coumarates are fluorescent.

16. Acid. Cresylic.—Turns brownish with $\text{NaNO}_2 + \text{HCl}$, changing to reddish brown with NaOH.

17. Acid. Gallic.—On adding Lime Water turbidity is produced, becoming grey green and darker.

Re Fehling's Solution Test, Allen says reduces slowly and imperfectly.

Turns deep brown with NaNO_2 alone.

19. Acid. Hippuric.—Boiled with Acids or Caustic Alkalies decomposes into Benzoic Acid and Glycocoll.

20. Acid. Malic.—Treated with Potash and Bromine Bromoform is formed.—Watts.

22. Acid. Nucleinic.—Schmidt II, 2, *p.* 1797, gives some information on the various Nucleinic Acids (animal, plant, yeast, etc.) but no very distinct analytical reactions. According to this authority Nucleinic Acids boiled with dilute Sulphuric Acid, their decomposition products yield Phosphoric Acid, Carbo-hydrates and Xanthin bases (Xanthin, Guanin, etc.). (Our tests were conducted with slightly brown Nucleinic Acid.)

23. Acid. Oleic.—Characteristic odour. Solidifies at $+ 4^\circ \text{C}$. Pure Oleic Acid as such does not redden Litmus, but does, however, in Alcoholic Solution. Nitrous Acid converts it into the stereoisomeric Elaidic Acid in crystalline leaflets, M.Pt. 45°C .

24. Acid. Oxalic.—A neutral alkaline salt Solution gives precipitate with soluble lime salt, insoluble in Acetic Acid, but soluble in HCl. Potassium Permanganate is decolorised in hot solution.

25. Acid. Pyrogallic.—In presence of Caustic Alkali rapidly darkens. (Takes up Oxygen).

27. Acid. Sclerotic.—Precipitated by Tannic Acid and Phosphomolybdic Acid.—Schmidt.

30. Acid. Tannic.—Gives precipitate with gelatin, $\text{Pb}(\text{NO}_3)_2$, $\text{Bi}(\text{NO}_3)_3$ and Ammoniacal Copper Sulphate.—(Distinctions from Gallic Acid). Is hydrolised into Gallic Acid by boiling with dilute Sulphuric Acid. Gives brown with NaNO_2 .

34. Acoine.—Gives brownish green with H_2SO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$; is precipitated both by acids and alkalies (Soluble 1 in 16,—P.J.i./10, 325; we found 1 in 30).

35. Aconitine.—There is no chemical identity test for; analyst has to rely on the sensation produced on the tongue in addition to the general characters stated.

35a. Acriflavine.—Dilute solution is yellow, strong solutions red with deep green fluorescence, gives HCl on heating with H_2SO_4 as distinct from Proflavine.

35b. Adalin.—Sulphuric Acid liberates H Br on warming gently. After heating with NaOH and acidifying with H_2SO_4 there is odor of acetic acid. CO_2 is evolved. It does not pp. with Millon's Reagent after acidifying.—See Malourea this chapter.—W. H. M., 1921.

A saturated aqueous Solution gives an immediate yellow colour and then an orange pp. with Nessler's Reagent. Dial, Malourea, Medinal and Proponal do not react except by fusing with KOH. Bromural and Luminal Solutions give a slight colour but the effect with Adalin is distinctive of the group.

36. **Adrenalin**.— NaNO_2 alone gives red color. For Phosphoretted Hydrogen odor with NaOH ,—*vide p. 153*. Reduces AgNO_3 Solution.

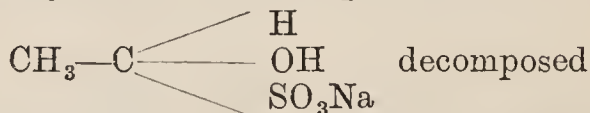
37. **Æsculin**.—Yields Glucose and Æsculetin on hydrolysis and then reduces Fehling's. Gives blood red color when treated with Nitric Acid and then excess of Ammonia. Gives blue fluorescence in alkaline solution. Treated with Sulphuric Acid and then solution of NaOCl gives violet color.—Allen, Watts.

38. **Æthyl Bromidum**.—Differs from the poisonous Ethylene Bromide by Sp. Gr. and boiling point.—*Vide Vol. I., p. 775*.

41. **Albumin Tannate**.—Nitrogen content 8%.—*Vide Vol. I., p. 100* for estimating its capabilities of withstanding Pepsin and Hydrochloric Acid.

42. **Alcohol Methylic**.—Method of detection in Ethyl Alcohol, see *p. 20*.

43. **Aldehyde Absolute**.—Shaken with Concentrated Sodium Bisulphite Solution gives crystalline addition-product



by acid or alkali. Combines with Phenylhydrazin forming Ethyliden-phenylhydrazone. Combines with Ammonia, forming additive compound.

43a. **Allantoin**.—A concentrated solution of furfurol, to which a little HCl has been added, gives a violet colour with an aqueous solution of Allantoin.

Mercuric Nitrate (not Chloride) gives a precipitate as with urea.

44. **Alloxan**.—Aqueous solution slowly turns red when applied to the skin. Solid NaOH turns spirituous solution blue, which is decolorised by water.

48. **Aloin**.—Ammonia changes an alcoholic solution of Barbaloin and Socaloin brown red, and Nataloin carmine red. Dieterich states the Aloins evaporated to dryness even in minute quantity with Nitric Acid (Sp. Gr. 1.4) on water bath, and the residue dissolved in alcohol, the red solution on adding a little Alcoholic KCN solution turns pink.

51. **Alypin**.—Behaves similarly to Cocaine, *c.f.*, *p. 56*. Can be distinguished by fact that 4% solution does not precipitate with Platinic Chloride in presence of HCl . (W.H.M.)

54. **Amyl Nitris**.—Characteristic odor,—produces flushing of face on inhalation,—for further information, *v. Vol. I., p. 146, et seq.*, and Vol. II., *p. 26*.

56. **Anaesthesin**.—Gives Isonitril reaction *c.f.*, Acetanilide.

57. Anhydro-Glyco-Chloral. Dilute Acids produce Chloral and Glucose.

58. Aniline.—A mixture of Nitric and Sulphuric Acids gives fine blue color. To neutral aqueous or slightly alkaline solution add Sodium Hypochlorite or Chlorinated Lime Solution,—purple violet even in 1 in 26,000,—changing to dirty red. Avoid excess of Reagent (Runge). When this change has occurred add dilute Ammoniacal Phenol solution, return of blue color (Jacquemin-Dragendorff) even in 1 in 66,000. Aqueous Chromic Acid Solution according to concentration, gives green, blue, or almost black (Fritzsche). For other tests *vide* Schmidt or special Aniline Color treatises. Diazo test gives red dye.

59. Anthrarobin.—Easily soluble in Caustic Alkalis and Ammonia, giving yellowish solution gradually changing to green or blue owing to formation of Alizarin

60. Antimonii et Potassii Tartras.—HCl Solution gives orange red pp. with H_2S soluble in Ammonium Sulphide and KOH. On "Marshing" black mirror insoluble in Sodium Hypochlorite Solution. With Lime Water white pp., soluble, when freshly precipitated, in Acetic Acid and Ammonium Chloride Solution.

65. Apomorphine HCl.—Solution in Sodium Hydrate rapidly becomes red and gradually black. Sodium Bicarbonate throws down precipitate which becomes green on standing.

Diazo test,—gives red color with HNO_2 fading to brown and finally red color with β . Naphthol Soda.

66. Arbutin.—Hydrolysed by dilute Sulphuric Acid into Glucose and Hydroquinone. Diazo Test,—yellow with HCl and $NaNO_2$ turning red with Sodium Hydrate.

69. Argenti Proteinæ.—Ammonium Sulphide colours solution blackish brown without causing pp. To 2 Cc. of Silver proteinate Solution (1 in 20) add 1 drop of 30% Acetic Acid, white caseous pp., soluble in excess.

Residue on incineration gives reactions for Silver. Picric Acid precipitates.

70. Argonin.—The results recorded in the chart were obtained with Argonin—*L*, the soluble preparation. Ammonium Sulphide turns solutions of it black without immediate precipitate.

72. Arrhenal.—See also XIVth Edition, p. 152.

73. Arsamin.—Diazo test gives positive reaction.—See also XIVth Edition, pp. 154 and 160.

73a. Arsenobenzene.—The arsenic content can be estimated by the methods given on p. 32. The general characteristics of the substance must be taken into consideration.

74. Asparagin.—In alkaline solution is lævorotatory; in acid dextro. Copper Hydrate is dissolved on boiling, forming blue solution, depositing on cooling Asparagin-Copper $(C_4H_7N_2O_2)_2Cu$.

75. Atropine Methyl Bromide.—Gives Vitali's reaction *vide* Atropine.

76. Atropine.—1 mgr. warmed with 2 Cc. of 5% Mercuric Chloride in 50% Alcohol causes deposition of Mercuric Oxide (with some Mercurous)—Gerrard. Dilates the pupil even in 1 in 130,000 dilution. Responds to **Vitali's Reaction**.—On evaporating a trace of Atropine or one of its salts in a porcelain dish with a few drops of fuming Nitric Acid a yellowish residue is produced which on moistening with Alcoholic Potash (1 in 10) produces a violet colour. Strychnine does the same on applying a 4 per cent. potash solution, but the colour is evanescent. Veratrin produces a reddish violet or orange red colour. **Atropine Sulphate.**—Gives Atropine Gold Chloride.—M.Pt. 136–138° C.

Barbitone.—See Malourea.

77. Benzol.—To distinguish from Petroleum Benzin note solubility in Alcohol. Benzol is soluble with half its volume of Alcohol 90%, but Petroleum Benzin requires 5 to 6 times its volume (using 'Petrol' considerably more.—W.H.M.) 1 Cc. Petroleum Benzin added to 5 to 10 times the quantity of a mixture of 2 parts Nitric Acid (Commercial) and 1 part Sulphuric Acid,—warm slightly:—Benzol gives with evolution of red vapors, yellow nitro compounds, then dilute with 10 to 15 times the quantity of water, odor resembling Bitter Almonds, especially on well diluting. Petroleum Benzin on this treatment is hardly affected. For Dragon's Blood Test, *vide* Vol. I., p. 301.

78. Benzyl Benzoate.—Decomposes into Benzyl Alcohol and Sodium Benzoate on boiling with NaOH.

79. Betaine HCl.—Gold Salt melts at 224° C.

80. Betol.—Alcoholic Solution gives violet color with Ferric Chloride Solution.

82. Bismuthi Citras.—Soluble in NH_3 and Alkali Citrates. Dissolved in Aqueous Ammonia and evaporated, Bismuth Ammonium Citrate is formed. Gives reactions common to Bismuth and Citrates.

83. Bismuthi Oxyiodogallas.—Easily soluble in mineral Acids and Caustic Alkalis. Gradually turns red in moist atmosphere.

84. Bismuthi Salicylas.—For estimation of Salicylic Acid, *v.* p. 43.

85. Bismuthi Subgallas.—NaOH dissolves it with yellow color—turning red.

86. Bromalhydrate.—Decomposes at 100–110° C. into Bromal and water.

87. Bromethylformine.—Heated with Soda Solution gives odor of Formalin.

90. Bromo-valerianyl-Urea.—Gives characteristic odor of bromal on heating. Dissolves in caustic alkali solution and is precipitated by acids. The Bromine can be estimated by a 'Carius' analysis.

After heating with NaOH and acidifying the residue with H_2SO_4 , CO_2 is liberated with strong odor of Valerianic Acid.

Millon's Reagent gives pp. (*c.f.* Malourea). Nessler's Reagent with a Satd. Solution produces only a slight color and pp. (*c.f.*, Adalin) but after fusing with KOH and dissolving in water there is the usual effect.—W. H. M., 1920.

91. **Butyl Chloral**.—Nitric Acid converts it into Trichlorobutyric Acid, M.Pt. 44°C .

92. **Caffeine**.—Heated with Nitric Acid forms Cholestrophan.

94. **Caffeine Sodium Salicylate**.—Estimation of Caffeine can be conducted by extracting with boiling Chloroform.

97. **Camphor Monobromide**.—Alcoholic Potash has no action, but Silver Oxide in presence of Chloroform decomposes it. With Hydroxylamine, forms Camphor-Oxime $\text{C}_{10}\text{H}_{16}=\text{N.OH}$. M.Pt. 118°C . Heated with 4 times its quantity of Nitric Acid on sand bath forms Camphoric Acid and Brom-Nitro-Camphor.—Rhombic prisms almost insoluble in alcohol. M.Pt. 105°C .

99. **Cantharidin**.—Solubility in water 1 in 30,000 only. Boiled with Soda and Potash forms Cantharidates. An exceedingly minute quantity of Cantharidin will produce a blister.

102. **Chinoline (Quinoline)**.—Diazo test gives slight brownish tinge.

Boiling point $236-238^\circ\text{C}$. A mixture of Sulphuric Acid and fuming Nitric Acid produces crystallised Nitro-Chinoline $\text{C}_9\text{H}_6\text{N.NO}_2$. On water bath H_2SO_4 produces mainly Cryst. *o*-Chinoline-Sulphonic Acid, $\text{C}_9\text{H}_6\text{N.SO}_3\text{H}$. The amorphous precipitate with Mayer's Reagent can be converted into amber yellow needles, on adding HCl.—Characteristic.—Allen.

103. **Chinosol**.—Diazo Test gives slight brownish red.

The Oxy-quinoline portion can be separated by Alcohol.—*c.f.* Vol. I., p. 306.

104. **Chloralamide**.—Water slightly warm decomposes. Caustic alkalis decompose it into Chloroform, Ammonia and Alkali Formate. Dilute acids have no action on it.

105. **Chloral Hydrate**.—Warmed with a little strong NaOH Solution, Chloroform is liberated.

105a. **Chloramine T**.—Does not pp. or coagulate protein (distinction from Di-Chloramine T). Mixed with equal vol. of Satd. aqueous KI Solution, Iodine is liberated. Gives white pp. with HgCl_2 Solution. (Di-Chloramine does not give the latter).

107. **Chrysarobin**.—Partially soluble in KOH Solution with red colour. Allen, 4th Edn., vol. V., p. 228, gives tests to distinguish Chrysophanic Acid from Chrysarobin.

M.Pts. of Commercial samples vary.

109. **Cinchonidine**.—Gives neither Thalleioquin Test nor the $\text{K}_6\text{Fe}_2\text{Cy}_{12}$ Modification (*c.f.* Cinchonine). Soluble in large amount of Ether. Sodium Potassium Tartrate in neutral solution of a salt gives white precipitate.

110. Cinchonine.—Only slightly soluble in Ether (1 in 370). There are few characteristic reactions. Not precipitated by NaHCO_3 in presence of Tartaric Acid (Quinine and Cinchonidine are).

Does not give Thalleioquin Test, nor red color with $\text{K}_2\text{Fe}_2\text{Cy}_{12}$ and Ammonia on addition of these to Acetic Acid Solution after treating with Br. (difference from Quinine and Quinidine). Not rendered fluorescent by very dilute Sulphuric Acid.

111. Cinnamic Aldehyde.—B.Pt. 245 to 247°. May be oxidised into Benzaldehyde and Benzoic Acid.

112. Citrophen.—Aqueous Solution is at first precipitated with NaOH Solution, then dissolved. Chromic Acid gives violet. Gives red color with Diazo reaction.

114 and 115. Cocaine and Cocaine Hydrochloride.—See p. 56 and Allen, 4th Edn., vol. VI., p. 322.

The identification of Cocaine and some Cocaine substitutes. Cocaine Salts and substitutes will react under certain conditions with Gold Chloride, Platinum Chloride, Chromic Acid and Potassium Permanganate to form precipitates which, when examined under the microscope, are found to possess definite and characteristic crystalline forms.

The Alkaloid, isolated in the usual way, is converted into the Hydrochloride and made up to a 2% solution and tested under definite conditions.—Am. Jl. Ph. 1911, p. 195.

116. Codeine Hydrochloride.—Does not reduce Iodic Acid (Morphine does). No blue color with Ferricyanide and Ferric Chloride (Morphine gives)—*c.f.*, Allen, 4th Edn., vol. VI., p. 392, 0.1 Gm. warmed with about 1 Cc. Sulphuric Acid and 1 drop of Fe_2Cl_6 solution gives deep blue color.

Greenish blue with Fröhde's Reagent.

117. Colchicine.—Only slightly soluble in Ether or Benzol. Practically insoluble in Petrol Ether. H_2SO_4 with a trace of HNO_3 added gives yellowish green changing to blue violet and wine red to yellow. (Dragendorff).

Cl water gives yellow precipitate with an aqueous colchicine solution soluble in NH_3 with orange color.—*c.f.* Allen, 4th Edn., vol. VII., p. 4. $\text{NaNO}_2 + \text{HCl}$ give dirty brown pp.

119. Conium Bases.—See also p. 58.

120. Cotarnine Hydrochloride.—Hager says 0.3 Gm. dissolved in 4 to 5 Cc. water and Iodo-Potassic Iodide added, brown pp. formed which recrystallised from Alcohol melts sharply at 142° C.

121. Cotarnine Phthalate.—Can be split up into Cotarnine and Phthalic Acid.

126. Cubebin.—With $\text{K}_2\text{Mn}_2\text{O}_8$ in alkaline solution oxidised to Piperonylic Acid and Oxalic Acid.—Schmidt.

127. Dextrose.— $[a]_D = + 104^\circ$ for the pure article in fresh solution. For the Hydrate $[a]_D = + 90$ to 96° . Aqueous solutions of silver are reduced especially when warmed. In addition to Fehling's, Barfoed's Reagent (warm) is also reduced (distinction from Dextrin and Maltose). Sodium, Calcium and Barium Oxides form saccharates soluble in water. Ferments with yeast (useful confirmatory test).

128. Dibromo-Tannin-Gelatin.—Gives violet with dilute NaOH.

129. Diacetyl Morphine.—M. Pt. 171° C. H_2SO_4 with a little HNO_3 gives yellowish red, darkening on warming. From Acid Solutions is precipitated by caustic alkalis, Ammonia and Ammon. Carb. redissolved by the first in excess. Does not color Ferric Chloride blue or reduce Iodates (distinction from Morphine).

130. Diacetyl Morphine HCl.—Gives reactions of the base.

131. Dial.—After heating with NaOH and acidifying the residue with H_2SO_4 , CO_2 is liberated with a pungent acetic odour. Millon's Reagent gives white pp. with a satd. solution, soluble in excess. *c.f.* Malourea.

Neither give pp. or colour with Nessler's Reagent, except after fusing with KOH.

131a. Di-Chloramine-T.—Almost insoluble in water. Precipitates and coagulates proteins. Soluble in alcohol, ether, and cotton seed oil, but decomposes them. Readily soluble in chloroform and eucalyptus oil without evident change. Dissolves in solutions of fixed alkalis forming the soluble mono-chloramine.

It is a powerful oxidising agent, readily liberates iodine from potassium iodide.—Jl. Pharm. & Exptl. Therap., Nov. '19.

Explodes on heating, smells strongly of chlorine, gives no pp. with $HgCl_2$ (*c.f.* Chloramine T.).

132. Digitoxin.—(See p. 61), HCl Sp. Gr. 1.19 dissolves it in the cold without coloration, but on warming it dissolves with brownish color.

133. Elaterin.—With Frohde's Reagent: first green then brown color. Mandelin's Reagent gives black. A solution of about 0.01 Gm. in 5 Cc. of melted phenol becomes crimson on adding a few drops of H_2SO_4 rapidly changing to scarlet.—U.S.

134. Emetine.—Sulphomolybdic Acid gives brown color changed to blue by HCl. Chlorinated Lime Test *vide* Allen, 4th Edn., Vol. VII., p. 42.

135. Emetine Bismuth Iodide.—Gives reactions for Bismuth and Iodine. Quickly loses its red colour on shaking with Sodium Bicarbonate and (more slowly) with Dilute Hydrochloric Acid (0.2% HCl). *c.f.* Expts., Vol. I.

137. Ephedrine base melts at 30° C.—Schmidt. See also p. 149.

138. Ergotinine.—Anhydrous Fe_2Cl_6 added to a solution in Concentrated H_2SO_4 gives yellow color passing through orange, crimson and green to a permanent blue. A dilute Acetic Acid Solution layered on Conc. H_2SO_4 gives an upper layer of violet and a lower one of green at junction of liquids.

140. Ethyl-Morphine HCl.—Does not give blue color with Ferric Chloride or reduce Iodates direct. 0.01 Gm. Dionine dissolved in 10 Cc. Sulphuric Acid after liberation of the HCl from the compound gives a clear solution which, on adding a drop of Ferric Chloride solution and warming turns violet to deep blue, changing to deep red on adding 2 to 3 drops of Nitric Acid. The free base (Ethyl Morphine) is less soluble in Ammonia than *Codeine*. Such solution reprecipitates the base in prismatic crystals melting at 93° C. Dionine is distinguished from *Morphine* in that, on adding it to a solution of Potassium Ferri-cyanide with Ferric Chloride it does not give an immediate blue; but gradually a bluish green color.—Hager.

141. Eucaïne Lactate and Eucaïne Hydrochloride.—1 drop of 1% Solution mixed with 1 drop of Mercuric Chloride Solution (1 in 20) gives no precipitate (difference from Cocaine).—P. Helv. This Pharmacopœia also gives an Ammonia precipitation test in several stages, *q.v.* Not colored by Fröhde's Reagent.

1 in 100 Solution gives no pp. with Potassium Iodide—Distinction from alpha-eucaïne—*Off.*

Moistened with HNO_3 and evaporated to dryness and alcoholic KOH added—Benzoic Ether odor.—Hager.

A 4% solution of the hydrochloride gives slight golden brown pp. with Platinic Chloride dissolving in HCl and throwing out again crystalline after a few minutes.

142. Eucalyptol.—1 Cc. placed in a freezing mixture, and equal volume of Phosphoric Acid added gradually: a solid white crystalline mass of Eucalyptol Phosphate results. If warm water be then added Eucalyptol will separate.—U. S.

Agitated with strong solution of Iodine in Potassium Iodide a pasty mass is produced in which green lustrous crystals are formed.—Allen, 4th Edn., vol. IV., p. 285.

143. Euresol.—Gives reactions of Resorcin and Acetic Acid. On cautiously heating 0.05 Gm. with 0.1 Gm. Tartaric Acid and 10 drops of H_2SO_4 a carmine red liquid is produced becoming pale yellow on diluting with water. On heating 0.1 Gm. with 1 Cc. 5% KOH Solution and a drop of Chloroform a crimson color results, changed to yellow by HCl (Test for Resorcin, U.S.).

144. Europhen.—Decomposed by water, Iodine being liberated Also decomposed by alkalis.

145. Exalgin.—Characters similar to Acetanilide.

146. Fluoresceïn.—Unmistakable fluorescence. Heated with zinc dust and caustic soda reduced to colorless Fluoresceïn.

Extremely dilute solution shows green by reflected light and yellow by transmitted light. Color discharged by Acid.

147. Formalin.—Adds Ammonia. Reduces Ammoniacal Silver Nitrate Solution (Mirror). Responds to Schiff's Reagent. See also Milk Tests, Urine Tests and Paraform.

148. Fuchsin.—Is decolorised by Zinc and HCl also by Sulphurous Acid. For detection of minute quantities as in urine, etc., see Schmidt, vol. II., 2, p. 1142, also p. 1771.

Diazo test destroys color,—dark brown with β . Naphthol.

Guaiacol gives dark reddish brown color with NaNO_2 and HCl .

149. **Gelseminine**.—With H_2SO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ reddish violet then green.

151. **Glycogen**.—Iodine gives Burgundy red (Schmidt). O.R., $[\alpha_D] = +193.63$. Amorphous, readily soluble in alkalis.

154. **Guaiacol Carbonas**.—Hydrolised gives reactions for Guaiacol.

155. **Guaiacol Cinnamas**.—Hydrolised gives reactions for Guaiacol and Cinnamic Acid.

156. **Hexamethylene Tetramine**.—Boiled with dilute acids decomposes into Formaldehyde and NH_3 .

157. **Holocain HCl**.—Yellow waxy pp. with NaNO_2 and HCl .

158. **Homatropine (HBr)**.—Dilatation of pupil which passes off rapidly in comparison with that produced by Atropine. Does not react to Vitali's test (Ac. Nitric Fuming, and Alcoholic KOH)—gives yellow instead of violet given by Atropine, *vide* Atropine this chapter. Does not precipitate with Tannic Acid or Platinic Chloride after previous addition of Hydrochloric Acid.

159. **Hydrastine**.—Froehde's Reagent green to brown color. Sulpho-Vanadic Acid gives orange red. To distinguish from Hydrastinine, p. 82.

160. **Hydrastinine**.—The Sulphate dissolves with fluorescence.

164. **Hyoscine HBr**.—Response to Vitali's reaction very similar to that with Hyoscyamine and Atropine.

165.—**Hyoscyamine Sulph**.—Reaction with Vitali's Test (Fuming Nitric Acid and Alcoholic KOH) similar to that with Atropine. *q.v.* Gold Salt (recrystallised from hot water) is in golden shining leaflets, M.Pt. $160-163^\circ \text{C}$. Solutions reduce in the light.

Does not precipitate with Platinic Chloride Solution.—Difference from most Alkaloids—U.S. The Sulphate is no longer official in U.S. The Hydrobromide is.

166. **Hypnal**.—Gives green pp. with NaNO_2 and HCl .

167. **Indigo**.—Purple vapors on heating in test tube. Color disappears on acting on it with Alkaline Reducing Agents, *e.g.*, NaOH and Zinc.

168. **Indigo-Carmine**.—Diazo test gives green color.

170. **Iohydrin**.— NaNO_2 and HCl liberate Iodine.

171. **Lævulose**.—Reduces Bismuth Salts in alkaline solution. On warming with KOH or NaOH turns brown (as also Glucose). Fermentable direct, but more slowly than glucose. Lævorotatory.

172. **Lecithin**.—Boiled with Baryta gives Glycerophosphoric Acid, Neurine and a fatty acid (Stearic, Oleic or Palmitic).—Watts.

173. **Luminal**.—After heating with NaOH and acidifying with H_2SO_4 , CO_2 is liberated with an acetic pungent somewhat sweet odor.

Gives pp. with Millon's Reagent, both before and after acidifying with HNO_3 , soluble in excess. Gives slight colour with Nessler's Reagent (marked after fusion, *c.f.* Malourea).

176. Malourea, Syn., Veronal.—A saturated solution acidified with Nitric Acid gives a white precipitate with Millon's Reagent, soluble in excess. This test is important from a forensic point of view.

Toxicological Analysis of Material for Veronal. The M. Pt., 191° C. is useful for identification. Substance must, of course, be pure. Viscera (take about 120 Gm.) are extracted with Alcohol and subsequently purified by Ether. *N.B.*—40 to 50% of the poison will probably have been excreted in the urine before death. Note that it gives no precipitate with the alkaloidal reagents; it is not decomposed by boiling with 20% Sodium Hydrate; it gives no brown color with Nessler's Reagent but after fusing with Caustic Potash, cooling and then adding the Nessler Reagent, the usual brown coloration of ammoniacal bodies is formed. Veronal Solution treated with two drops of dilute Nitric Acid and then with Millon's Reagent gives a white gelatinous precipitate soluble in excess of the Reagent.—W. H. Willcox. L. ii./13,1179.

Veronal, detection of in stomach contents and urine. Fusion with Alcoholic Soda is the most characteristic.—W. Macadie, P.J. i./13,134.

According to our experiments (1921) with Millon's Reagent.—

Saturated aqueous solutions *not* acidified with HNO_3 , of

Adalin	}	give pp. with this reagent, all soluble in excess, except that with adalin which is not readily soluble.
Bromural		
Dial		
Luminal		
Malourea		
Proponal		

If the saturated solutions be first acidified with a few drops of dilute HNO_3 the same remarks apply but there is *no pp. with Adalin*. Acidifying Sodium Malourea (Medinal) of course throws out the Barbituric Acid.

177. Mannitol Nitras.—Explodes at 120° C.

178. Medinal.—This being the Sodium Salt of the last mentioned, it gives the reactions characteristic of Veronal. It is soluble 1 in 5 as against 1 in 145 for veronal. On acidifying a saturated solution, the parent body is thrown out and can be identified. The Sodium may be titrated, using phenolphthalein.

179. Methylamino-oxy-benzoas.—Distinguished from Cocaine-Eucaine, Stovaine, Holocaine, Novocaine, Aypin and Tropacocaine by Frohde's Reagent, which gives a faint violet tinge, but nothing with the others except Tropococaine which gives slight green. Does not give Diazo reaction, but turns yellow with NaNO_2 and HCl .

182. Methylene Blue.—Nitrous Acid converts it into Methylene green.

183. Migralgin.—Gives reactions of Phenazone, and Caffeine. The Citric Acid present is not easily detected—Solutions give no pp. with CaCl_2 .

The Phenazone may be precipitated with Potassio-Mercuric Iodide (Caffeine is not precipitated). The presence of Antipyrin does not interfere with the Caffeine yielding the murexid reaction provided all the Phenazone precipitated with Br. Water is filtered out first.

If to a strong solution of Migralgin Ferric Chloride Solution be added in excess, then HCl , the red color is destroyed and a yellow pp. formed. Phenazone also gives this reaction.

Migralgin gives green color and pp. with NaNO_2 and HCl .

184. **Morphine HCl.**—Reddish Violet quickly changing to Slatey Blue with Frohde's Reagent. Liberates Iodine from Iodic Acid. Gives blue pp. with Fe_2Cl_6 and $\text{K}_6\text{Fe}_2(\text{CN})_{12}$. Solution (freshly prepared).

186. **Nicotine.**—Dropped on paper causes a grease spot which disappears after a time. Phosphomolybdic Acid gives yellowish pp. For formation of Periodide (Roussin's crystals), see Hager.

187. **Nitrobenzene.**—Detection of traces: Distil with a little Sulphuric Acid in steam, shake distillate with Chloroform, convert. Oily drops into anilin by reduction with Zinc and Sulphuric Acid.

188. **Novocain.**—Diazo test gives red dye.—Note also distinctive colors in chart. See also p. 57.

189. **Nuclein.**—*c.f.* Acid Nucleinic.

190. **Orexin Tannate.**—Gives Carbylamine reaction on heating with NaOH and CHCl_3 . Turns resinous with dilute HCl . in the cold, but dissolves on heating.

191. **Paraform.**—Characteristic odor of Formalin on heating Distillate (Formalin collected in water) reduces Silver Nitrate (forming mirror). Responds to Schiff's Test (Sulphurous Fuchsin Solution). Sodium Nitroprusside 0.5% gives reddish color which on acidifying with Acetic Acid is changed to purple.

Nessler's Reagent gives a reddish precipitate which gradually changes to gray.

If to 5 Cc. Sulphuric Acid in which a little Salicylic Acid has been dissolved, 2 drops of Formalin Solution (37%) be added and the liquid very gently warmed, a permanent deep red color develops (U.S.). In general the distillate gives reactions of Aldehydes.

192. **Paraldehyde**—is more soluble in cold water than hot,—saturated aqueous solution becomes turbid on warming. Gives mirror with Ammoniacal Silver Nitrate Solution on warming. Gives in general reactions of Aldehydes, but does not add Ammonia nor Sodium Bisulphite.

When warmed with a little sulphuric acid, it is converted into Acetaldehyde.

194. **Petroleum Ether.**—Does not dissolve Dragon's Blood (distinction from Benzene).

195. **Phenacetin.**—Potassium Dichromate in HCl Solution gives deep red colour, 1 Cc. of a solution of 0.2 Gm. Phenacetin in 2 Cc. HC , (25%) boiled, cooled and filtered gives reddish violet on adding 5 drops of fresh Cl water.

196. **Phenalgin.**—Alcoholic extractive evaporated to dryness gives reactions of Acetanilide.

197. **Phenazone.**—Gives green pp. with HNO_2 .

Aqueous Solution gives with equal volume Nitric Acid yellow solution changing to crimson on warming. Tannin solution gives a white precipitate with a 1% solution.

199. **Phenazoni Salicylas.**—Green color with Sodium Nitrite and HCl .

200. Phenocoll HCl.—On treating 1 Cc. of solution of 0.2 Gm. in 2 Cc. of HCl (25%) boiled, cooled and filtered with 5 drops of fresh Cl water gives reddish violet color. 0.1 Gm. boiled with 2 Cc. 33% NaOH and then 2 drops of CHCl_3 added gives powerful Isonitrile odor and black oily drops float on surface.

202. Phenolphthalein.—Red color with caustic alkalis disappearing with Acids. Silver Nitrate gives violet pp.

202a. Phenoquin.—M.Pt. about 210°C . A saturated solution, in hot HCl gives a pp. of reddish brown crystals with platinic chloride solution.

Dissolve about 1 Gm. in an excess of Ammonia and evaporate to dryness on the water bath or until free from NH_3 odour. Dilute with water to 20 Cc. and filter. Separate portions of this solution give a white flocculent pp. with Silver Nitrate solution, a yellowish pp. with Lead Acetate solution, and a green flocculent pp. with copper sulphate solution.—U.S. IX.

203. Phloridzin.—Solutions have great avidity for Ammonia. In taking up 10% it turns to red and melts at the same time to a colorless mass.

Mix 0.1 gm. with a crystal of Vanillin and 1 drop of HCl conc. and warm,—a fine red colour will result.

204. Physostigmine.—Calx Chlorinata turns a solution intensely red, but on further addition completely decolorises.

It gives a brown color with NaNO_2 and HCl turning blue with NaOH.

205. Physostigmine Sulph.—Brown color with NaNO_2 and HCl, violet pp. with NaOH.

206. Phytin.—Solution throws down a pp. on heating. This is prevented by mineral acids, but not by Acetic.

Gives Reactions of Calcium and Mg. (Al. ?).

207. Picrotoxin.—Mixed with 3 times its weight of KNO_3 and then moistened with H_2SO_4 and then NaOH in excess added gives intense red color.—Langley's Reaction.

To a trace on a watch glass add 1 drop 20% Benzaldehyde in absolute Alcohol and then 1 drop H_2SO_4 without shaking,—violet color (Melzer).

208. Pilocarpine.—To a solution in Conc. H_2SO_4 add a trace of Potassium Bichromate,—bluish green immediately changing to fairly permanent green.

Phosphomolybdic Acid, Phospho-Tungstic Acid and Iodo-Potassic Iodide pp. from HCl solution.

209. Pilocarpine Nitrate as Pilocarpine.

210. Piperazin.—Dissolves Uric Acid forming the neutral urate. Piperazin Phosphate forms 4-sided tabular crystals.

Gives white pp. with Nessler's Reagent.

Forms crystalline pp. with NaNO_2 and HCl.

For further details, *vide* Allen, 4th Edn., vol. VII., p. 200.

211. **Piperazin Benzoate.**—Aqueous solution acidified with HCl throws out Benzoic Acid. The Aqueous Solution gives test for Piperazin *q.v.*

213. **Podophyllin.**—Podophyllotoxin constituent of, M.Pt. 117° C.

214. **Propenal.**—After heating with NaOH and acidifying with H_2SO_4 , CO_2 is evolved with a very pungent acid vapour having odour resembling menthol to some extent.

Saturated solution gives white pp. with Millon's Reagent—*c.f.* Malourea. No colour with Nessler's Reagent except on fusing with KOH.—W. H. M., 1921.

Proflavine.—Solutions similar to those of Acriflavine. The substance being in this case a sulphate gives the reactions corresponding. Reduces Permanganate readily. N.B.—An unfortunate misprint in the formula, Vol. I., p. 298. The J_2 should be to the left of the H_2 . The base is a diacidic as explained on p. 299.

215. **Pyramidon.**—Gives violet colour with NaNO_2 and HCl.

217. **Quinine Sulphate.**—Dissolves with blue fluorescence in H_2SO_4 , Acetic Acid and Tartaric Acid. For substances interfering see Hager, p. 745.

Gives white pp. with NH_3 soluble in Ether and in excess of NH_3 . Thalleioquin Test with Cl and NH_3 .

The Thalleioquin Test is distinctive for Quinine and will show less than 0.0001 Gm. The presence of Belladonna, Colchicum, Conium, Gelsemium, Ipecacuanha, Opium, Nux Vomica do not inhibit the reaction at all. Work with dilute Solutions.—Am. Jl. Ph. Nov. 1912.

218. **Resorcin.**—On cautiously heating 0.05 Gm. with 0.1 Gm. Tartaric Acid and 10 drops Conc. H_2SO_4 thick carmine red liquid produced which becomes yellow on diluting with water. Ammoniacal AgNO_3 solution is reduced forming Mirror (*s.a.*).

Not precipitated by neutral Lead Acetate (distinction from Pyrocatechin).

Gives brown pp. with NaNO_2 and HCl.

Blueish Violet with Fe_2Cl_3 changing to brownish yellow on adding NH_3 : distinction from Catechol and Quinol.—U.S.

219. **Saccharin.**—Dissolved in 25% KOH *q.s.* and Br. water added till yellow coloration, Br. substitution body is gradually thrown out. Heated with Resorcin and H_2SO_4 yellowish red then dark green color. After cooling dissolve the mass in water and add NaOH in excess,—intense green fluorescence (a minute quantity will give this).

220. **Salacetol.**—Gives on alkaline hydrolysis reactions of Salicylic Acid and the hydrolysed liquid reduces Fehling's Solution, smells of Methyl Salicylate and burnt sugar and turns dark yellow.

221. **Salicin.**—Heated with Potassium Dichromate, a few drops of Sulphuric Acid and some water gives Salicylic Aldehyde (odor of Meadow Sweet).—Or dissolves in Hydrochloric Acid which on boiling throws out resin (Saliretin).

222. **Salicyl - Salicylas.**—Yields Salicylic Acid on hydrolysis. Formula $C_6H_4.OHCOO.C_6H_4COOH$, *i.e.*, Salicyl-Salicylic Acid.

223. **Sal Limonis.**—Calcium Chloride gives white pp., insoluble in Acetic Acid. Potash flame. Decolorises $K_2Mn_2O_8$ with effervescence on warming at 60–65° with Ac. Sulph. dil.

225. **Salol.**—Alcoholic Solution precipitates with Bromine. Violet with Ferric Chloride in alcoholic solution. Test for Phenol and Salicylic Acid after melting with Soda.

226. **Saloquinine.**—On hydrolysis gives reactions of Quinine and Salicylic Acid.

228. **Santalol Salicylas.**—Alcoholic solution colored violet by Fe_2Cl_6 solution.

232. **Sodium Glycerophosphate.**—On incineration Pyrophosphate is formed.

Lead Acetate precipitates but not Magnesia mixture. Cold Ammonium Molybdate, either precipitates on standing or heating.

233. **Sodium p-aminophenylarsonate.**—See also *p.* 31, and previous Editions for further analytical information.

235. **Sodium Sulphocarbolate.**—Dilute solution does not give yellowish brown with Uranium Nitrate solution (distinction from Salicylate), Soda flame.

237. **Sodium Taurocholate.**—Taurocholic Acid forms shining hygroscopic bitter needles easily soluble in water and alcohol. Solutions dextrorotatory. On heating with water at 100° C. or boiling with KOH or acids, decomposes into Cholic Acid $C_{24}H_{40}O_5$ and Tannin $C_2H_7NO_3S$. Watts and Schmidt.

To aqueous Solution of the Sodium Salt add $\frac{2}{3}$ bulk of Sulphuric Acid and a few drops of Syrup. Intense violet color develops.—Pettenkofer's Bilc Acid Test.

238. **Sparteine Sulphate.**—For further tests *vide* U.S., Ammonium Sulphydrate forms permanent orange red color.

240. **Strophanthin.**—Re the Ferric Chloride test—add a trace of Ferric Chloride to an aqueous solution, then Concentrated Sulphuric Acid to an aqueous solution of strophanthin. A brownish pp. is formed which changes in two hours to dark green.

Solution dextrorotatory.—(U.S.).

241. **Strychnine.**—Gives Violet with $K_2Cr_2O_7$ and H_2SO_4 , and a yellow passing into reddish violet with Vitali's Reaction *v.* Atropine, this chapter.

Mandelin's Reagent gives blue color changing to vermillion. On adding alkali a permanent pink to purple color results.

Phospho-molybdic Acid will show 0.0001 Gm., Picric Acid 0.00005 Gm., Tannic Acid 0.00004 Gm., Mercuric Potassium Iodide 0.000006 Gm., Potassium Bismuth Iodide 0.00002 Gm., Platinic Chloride only 0.001 Gm., and Gold Chloride 0.0001 Gm.—Dragendorff.

242. **Sucrose.**—Conc. KOH turns this brown on *heating*. (Glucose is turned brown in the *cold*.) It is not directly fermentable—requires inversion first by yeast or dilute acids into glucose and laevulose.

244. **Terpineol.**—B.Pt. 218–219°.

245. **Terpin Hydrate.**—Conc. HI converts into $C_{10}H_{16}2HI$.

246. **Tetra-Iodo-Pyrrol.**—Warmed with NaOH and Zinc filings, fumes of Pyrrol are given off. These color pine wood, *e.g.*, a match soaked in HCl bright red. Gives bright red on warming an alcoholic solution with Nitric Acid (Allen).

247. **Theobromine** gives Murexide Test. Precipitates Silver Theobromine on adding $AgNO_3$ Solution to very dilute Solution of Theobromine Nitrate. Sodium phospho-tungstate gives yellow pp.

Heated with dilute H_2SO_4 and Lead Dioxide (avoiding excess) CO_2 is evolved. The product precipitates Sulphur from H_2S , colors skin purple red and turns blue with moderate amount of Magnesia.

249. **Theobromine-Sodium Acetate.**—Gives murexide reaction. Aqueous solution 1 in 5 neutralised with dilute Hydrochloric Acid in presence of Litmus Solution gives white precipitate of Theobromine. (A little alkali assists its solubility in water.)

250. **Theobromine-Sodium Salicylate.**

On acidifying with Hydrochloric Acid, Salicylic Acid is thrown out which may be identified. Theobromine may be removed from the filtrate with Chloroform, this will give the Murexide Reaction.

251. **Theophylline.**—Gives Murexide Reaction.

252. **Theophylline Sodium Acetate.**—Gives reactions of Theophylline and also of Acetate (after removing the Theophylline by neutralising and filtering).

257. **Tiodine.**—Contains Thiosinamin *q.v.*

$NaNO_2$ and HCl gives brown pp. turning yellow with Naphthol.

Yellow pp. with Pb. Acet., insoluble in dilute HNO_3 , but blackened by conc. HNO_3 .

258. **Toluol.**—Sp. Gr. 0.872 at 15° C. Yields Benzoic Acid on oxidation.

260. **Tribromphenol Bismuth.**—Gives Bismuth Reactions using an acidulated extractive.

261. **Tropacocaine HCl.**—Boiled with HCl this is converted into Benzoic Acid and pseudo-tropine.

262. **Tylmarin.**—Soluble in Chloroform 1 in 14 (distinction from Acid Coumaric, which is only very slightly soluble).

263. **Urea.**—Gives Biuret Reaction. Decomposes with Hypobromite (*vide p. 95*, also Albumoses and Urine Anal. Chapter).

264. **Urethane.**—M. Pt. 50° (we find considerably more soluble than other published statements).

265. **Veratrine.**—Gives Vitali's Reaction *q.v.*

266. **Zinc Sulphocarbolate.**—Yellowish green pp. with Pot. Ferro-cyanide insoluble in HCl (method of distinction of Zinc from Aluminium in analysis).

Approximate Melting Points and Consistence (*Atmospheric Temperature, 11° C*) of some Fats and Waxes suitable for Suppositories, Pastes, Creams, and Ointments.

	31-32° C.	87-8-89-6° F.	
Oleum Theobromatis			Yellowish white, hard, brittle, and melts with ease.
Sevum Præparatum } equal parts	39	102-2	Rather hard and brittle, but melts with ease
Oleum Theobromatis } equal parts			{ Stiff paste. Easily softened with the fingers Suitable for thick creams.
Paraffinum Molle	33-34	91-4-93-2	
Oleum Theobromatis	35-39	95-102-2	White, soft base.
Paraffinum Molle	35	95	Soft, white, unctuous.
Unguentum Cetacei, (<i>Off.</i>)	38	100-4	Hard, tough, and tenacious, tallowy. Obtained from <i>Rhus</i> species.
Adeps	50	122	Yellowish, stiff, tenacious, unctuous.
Japan Wax	40-44	104-111-2	{ Hard. Melts easily between the fingers. Not so brittle as Oleum Theobromatis.
Adeps Lanæ	39-40	102-2-104	Soft and unctuous.
Oleum Theobromatis } equal parts			Crystalline, scaly and slippery.
Cetaceum	47	116-6	Stiff unguent.
Sevum Præparatum	46-50	114-8-122	Very hard white mass
Cetaceum	47	116-6	
Unguentum Paraffini, (<i>Off.</i>)	52	125-6	Hard glossy mass. Easily melts between the fingers.
Ceresin } partes æq.			Hard, white and brittle.
Stearin	51-52	123-8-125-6	Hard, like good paraffin.
Cera Alba 1, Oleum Theobromatis 6.....	48-51	118-4-123-8	White, hard, crumbling substance.
Japan Wax, Hard Paraffin, equal parts	52-53	125-6-127-4	Crystalline, hard and unctuous (slightly greasy):
Ceresin	53-54	127-4-129-2	
Stearin	54-57	129-2-134-6	
Paraffinum Durum.....	54	129-2	Stiff white pomade.
Unguentum Resinæ, (<i>Off.</i>)	59	138-2	Very hard, white mass
Adeps 3 with Cera Alba 1	58	136-4	Hard as last, but not so white in appearance:
Adeps, Cera Alba, equal parts	58-59	136-4-138-2	White, hard, tenacious.
Cetaceum, Cera Alba, equal parts	62-64	143-6-147-2	Hard, yellowish, from leaf buds of <i>Copernicus cerifera</i> (a palm growing in Brazil).
Cera Alba.....	85	185	Stiff mass, melting easily.
Carnauba Wax	77-78	170-6-172-4	Stiff ointment of brownish colour.
Carnauba Wax 1, Oleum Amygdalæ 4	78-79	172-4-174-2	Hard and wax-like.
Carnauba Wax 1, Oleum Amygdalæ 3	60-61	140-141-8	Stiff ointment.
Cera Alba, Oleum Amygdalæ, eq. pts.	54	129-2	Stiff ointment base
Cera Alba 1, Oleum Amygdalæ 5	52-53	125-6-127-4	Very soft creams.
Cera Alba 1, Oleum Amygdalæ 9	48-49	118-4-120-2	
Cera Alba 1, Oleum Amygdalæ 19	43	109-4	
Cera Alba 1, Oleum Amygdalæ 39			

FREEZING MIXTURES.

For cooling and setting suppositories, bougies, &c.

The following is a list of some freezing mixtures best prepared from commercial Crystalline Salts and in a thick wooden vessel:—

						Temp. F reached.
Ammonium Nitrate 1, Water 1	..	..	..	..	..	+ 1.4
Sodium Nitrate 3, Dilute Nitric Acid 2	..	..	..	..	..	— 3
Ice 2, Sodium Chloride 1	..	..	..	..	..	— 5
Ammonium Nitrate 1, Sodium Carbonate 1, Water 1	..	..	..	..	..	— 7
Ice 24, Sodium Chloride 5, Ammonium Nitrate 5	..	..	..	..	..	— 18
Ice 3, Sulphuric Acid 2	..	..	..	..	..	— 23
Ice 8, Hydrochloric Acid 5	..	..	..	..	..	— 27
Ice 3, Dilute Nitric Acid 2	..	..	..	..	..	— 46
Sodium Phosphate 3, Ammonium Nitrate 2, Dilute Mixed Acids 4	..	..	..	..	..	— 50
Ice 8, Dilute Sulphuric Acid 10	..	..	..	..	..	— 91

DROP MEASURE TABLE.

Showing the number of drops per gramme of various medicaments delivered (at 15° C.) by a standard pipette 3 mm in external diameter (see 'Weights and Measures'). Adapted from F.E.

	No. of drops in 1 Gm.
Acetum Opii Compositum	54
Acidum Hydrochloricum (1·171)	21
„ Hydrocyanicum Dilutum (2%)	22
„ Nitricum, Sp. Gr. 1·321	25
„ Phosphoricum, Sp. Gr. 1·35 (50% H_3PO_4)	19
„ Sulphuricum, Sp. Gr. 1·843	26
„ Sulphuricum Alcoholisatum (Aqua Rabeliana) (Sulphuric Acid 1, Alcohol 3) (cautiously mixed)	55
„ Sulphuricum Dilutum 10%	21
Æther	19
„ Aceticus, Sp. Gr. 0·915	60
„ Sulphuricus Alcoholisatus (Hoffman's Anodyne) ·Ether 4 and Alcohol 1, mixed)	73
Aqua Distillata	20
Chloroformum, Sp. Gr. 1·48	60
Creosotum, Sp. Gr. 1·08	42
Liquor Ammonia, Sp. Gr. 0·923	24
Oleum Crotonis Tiglii (Acete de Croton Tiglio)	44
„ Menthae Piperitæ, Sp. Gr. 0·89 to 0·92	52
„ Terebinthinæ	56
Solutum Chloruri Ferrici, Sp. Gr. 1·26 (Liquor Ferri Perchloridi)	18
Tinctura Alcoholica Aconiti (1 of Root in 10)	58
„ „ Belladonnæ, 1 in 10	59
„ „ Cantharidis, 1 in 10 (with Cochineal 1·5 in 100)	58
„ „ Castorei, 1 in 20	57
„ „ Colchici, 1 in 10	59
„ „ Corticis Aurantii (Naranja) Composita (Tinctura Roborans ex Whytt)	63
„ „ Digitalis, 1 in 10	58
„ „ Fabæ Sancti (Haba de San Ignacio) (Ignatii Composita) Guttæ Amaræ ex Baumé 1 in 2	58
„ „ Hamamelidis (bark and leaves of each, 1 in 20)	58
„ „ Hydrastis, 1 in 10	58
„ „ Iodi (1 in 10, Alcohol 95%) (Solution Alcoholica de Yodo)	62
„ „ Lobelia, 1 in 10	58
„ „ Moschi (Almizcle) 1 in 25	55
„ „ Nucis Vomica, 1 in 10, 0·25% Alkaloids approxi- mately	57
„ „ Opii Extract, 1 in 20)	58
„ „ Scillæ (escila) 1 in 5	58
„ „ Scillæ (escila) 1 in 5	58
„ „ Strophanthi (Estrofanto) 1 in 10	58
„ „ Viburni, 1 in 10	58
(all the above tinctures are made with Alcohol 70%).	
Opii Compositum (Laudanum ex Sydenham)	40

SYNTHETIC NOTES.

Physiological effect in comparison with Chemical constitution of Drugs.

There are various theories of the action of Poisons on the cell elements of the body. That of *Ehrlich* suggests that the poison becomes attached to the tissues by various chains or anchors before the poisoning can take place. The theory maintains that when these chains or groups become somewhat altered the union takes place with another cell structure, hence causing a different result.

The theory of *Loew* holds that substances which *can act on Aldehyde or Amino-groups* must be poisons to living tissues—they will act by substitution. According to him the greater the reactivity the greater the physiological result, *e.g.*, **Phenylhydrazine** and **Hydroxylamine** are very reactive to Ketone and Aldehyde groups,—hence poisonous both to plants and animals. *Aniline* is less reactive to Aldehydes than Phenylhydrazine and is less poisonous than the latter. If the chemical properties of a poison are *made more labile* by a change in the character of the molecule, then it becomes *more toxic* and *vice versa*, *e.g.*, if the Hydrogen of the NH group in many alkaloids be replaced by a Methyl group the toxicity is diminished as the substance reacts less readily with Aldehydes. Similarly Piperidine is more toxic than Pyridine and Tetra-hydroquinoline is far more toxic than Quinoline by reason of the fact that the reduced Compounds which contain secondary Nitrogen in place of tertiary have a greater reactivity with protoplasm. Compare also Pyrogallol (Trihydroxybenzene) which is more poisonous than Dihydroxybenzene (Catechol) and Phenol. The toxicity of Phenols is in the light of this theory attributed to their reactivity,—especially with Aldehyde. *Salicylic Acid* (introduction of COOH) is less reactive with Aldehydes than Phenol, hence less toxic. **Loew's Theory** only applies to certain bodies reacting with Aldehyde and Amino groups, it does not explain selective action. Every tissue contains labile Aldehyde and Amino groups,—hence should react with a drug.

Reverting to **Ehrlich's Theory**,—in the example of **Morphine** it is thought that one of the anchors may be one of the OH groups. If these are combined with H_2SO_4 (forming Morphine-Sulphuric Acid) the substance cannot attach itself to nerve tissue, hence Morphine-Sulphuric Acid has no hypnotic effect. (Another explanation of this may be purely physical—the compound is far less soluble). The entrance of an organic radicle—Methyl, Ethyl, Acetyl causes the *hypnotic power to be reduced* whilst action on the *respiratory* centres (produced by Morphine to a slight extent) is much increased, *e.g.*, in the case of **Codeine** and **Diacetyl Morphine**.

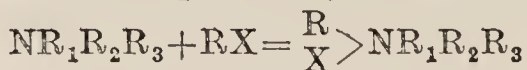
The relationship between **Arecoline** (the Methyl Ester of **Arecaidine**) and **Arecaidine** exemplifies the fact that in cases where the presence of an Acid group prevents the substance from acting physiologically in spite of the presence of an anchoring group,

the conversion of the acid into an Ester causes the physiological action to appear. The Methyl group in this case does not cause the marked difference,—the effect resides in the Arecaidine which is prevented from showing itself by the Acid group present,—*c.f.*, also Benzoyl-Ecgonine and its Methyl Ester which is Cocaine. Note that analogous effects can be brought about by Ethyl as by the Methyl group. When the Carboxyl group in the molecule is masked we get anæsthetic effect.

With regard to the question of physiological action depending on chemical change of the substances while passing through the organism, a few observations may be offered between some closely related compounds. Wide generalisations cannot be made in these questions,—a case to illustrate this is the decomposition of Xanthine, Theobromine and Caffeine, the first being without action on the heart muscle, the second acting slightly and the third showing more marked toxic action. It was found that the products of metabolism after giving Caffeine and Theobromine contain Xanthine bases poorer in Methyl groups than the substances given,—the Methyl groups had been split off. In man Caffeine is reduced to Theophylline,—this shows that there is a *splitting off of Methyl groups* which groups appear to be responsible for action on the heart, *i.e.*, there is a relationship between physiological action and the changes undergone by the substance in the organism. It is, therefore, often useful in devising new Synthetic Drugs to determine the substances that are formed in the organism when an unsuitable substance is administered. Aniline, for example, is eliminated as Para-amino-phenol,—this led to the introduction of a number of derivatives of this substance of which Phenacetin is the best known example. We shall revert to the question of alterations that take place in drugs passing through the system later.

With regard to the Alkaloids in general,—these seem to pass through the system for the most part *unaltered* and their action is in most cases difficult to explain. It is clear that if a substance is easily acted upon it will react *with all tissues* and hence produce no specific effect. (Hydrocyanic Acid can only be given in small doses for this reason.)

Whilst mentioning Alkaloids we should add the classic discovery of Crum Brown and Fraser. They showed that various Alkaloids possessing the most diverse physiological actions on combination with Alkyl halides to form quaternary Ammonium derivatives,



where $\text{R}_1\text{R}_2\text{R}_3$ are Organic Radicles of any complexity and RX stands for Alkyl halide, Methyl or Ethyl Iodide, etc., yield substances in almost every case possessing the property of paralysing the motor-nerve endings in the same way as Curare. One can obtain therefore by *Methylation* from all tertiary bases, **quaternary Ammonium Compounds** which are *poisonous* compared with the original bases. Curare itself contains the tertiary base Curine which is not very

poisonous, as well as the far more poisonous Ammonium base Curarine. *Curine on methylation yields Curarine which is 226 times as poisonous as the original substance.*

The fact that the action of **Inorganic Salts** injected into the blood depends on the *electro-positive* half is analogous with the action of most **Esters** which generally resembles that of the Alcohol concerned—in both cases the Acids are usually physiologically inert.

Isomorphous Substances in a group have similar action, *e.g.*, Li, Na, Rb, Cs, Ag, Tl, and the physiological intensity usually increases proportionally to the Atomic Weight. Potassium and Ammonium are exceptions. In **negative elements**, *e.g.*, the **halogens**, there is no relation between physiological effect and atomic weights.

Ionisation plays an important part in the action of substances, *c.f.*, HgCl_2 which is ionised in solution and extremely poisonous and $\text{Hg}(\text{CN})_2$ which is almost non ionised (though soluble) and far less poisonous, *c.f.*, also HgCl_2 and HgCl .

Meyer and Overton found that practically all narcotics are more soluble in lecithin and cholesterine than in water and they conclude that the narcotic value of a drug depends principally on its solubility in the liquid substances.—J. Grier, B. and C.D. i./13,282.

Schmiedeberg's Rules regarding action of Aliphatic Compounds.

The action of these depends on *volatility and solubility*, *c.f.*, the lower with the **higher** members of the series of **Paraffins**.

(1). Poisonous radicles on substitution by simple Alkyl groups lose in intensity, *e.g.*, **Arsenious Oxide**, $\text{O}=\text{As}-\text{O}-\text{As}=\text{O}$ and **Cacodyl Oxide** $(\text{CH}_3)_2\text{As}-\text{O}-\text{As}(\text{CH}_3)_2$.

(2). The effect of the Alkyl groups can on the other hand be lost or lessened by combining with other atoms or groups, *e.g.*, the Mono-Di- and Tri-methylamine behave like Ammonia and have no narcotic action, but the first rule holds here also as these Amines are less toxic than Ammonia.

(3). The action of a body made by *uniting two groups by an Oxygen atom depends on the two components* each acting separately. Where the two groups are similar or equivalent alkyl groups, *e.g.*, in the **Simple and Compound Ethers** then the action of the whole is simple and the resulting body resembles in action the corresponding Alcohol. Analogous are the Esters, the acids of which yield neutral (Sodium) Salts without any specific physiological action. Acetic Ester and its homologues are therefore classed with the Alcohols. If the Acid however has a specific action of its own then this shows itself in the Ester and has a modifying effect on the action of the Alkyl group,—*e.g.*, **Amyl Nitrite**.

The **Hydrocarbons** of the **Methane series** are less active than the *Ethylene, Acetylene or Benzene Series*. In the **Methane Series** commencing with the lower members we have the *anaesthetic and narcotic action*—this decreasing with loss of volatility and solubility. In the **Ethylene series** there is also evidence of narcotic action,

e.g., Amylene. The **Benzene Hydrocarbons** show *paralyzing action on motor nerves* and further action on the *brain and spinal cord*.

Effects of Alkyl Groups,—in addition to those provided under Schmiedeberg's rules, P. May mentions a number of others. Methyl groups introduced into Ammonia produce Tri-methylamine which is free from convulsive effects, *c.f.*, also the effect of introducing Methyl groups into the Amino group in Aniline, but if the Hydrogen of the nucleus be replaced by Methyl groups there is an increase in the effects, *c.f.*, also the methylation of **Xanthine** (*antea*). *Replacement of the Hydrogen* of an Hydroxyl group often reduces activity, *c.f.*, Catechol $C_6H_4(OH)_2(1:2)$, Guaiacol $C_6H_4OH.OCH_3$ and Veratrole $C_6H_4(OCH_3)_2$. Again *Ortho*-methoxybenzoic Acid $C_6H_4OCH_3COOH$ and Anisic Acid $CH_3O.C_6H_4.COOH$ are less active than Salicylic Acid $C_6H_4OH.COOH$, but this is not invariably true—Resorcin $C_6H_4(OH)_2(1:3)$ is far less poisonous than Dimethyl-resorcin $C_6H_4(OCH_3)_2(1:3)$.

Ethyl groupings have a marked influence in causing action on the *central nervous system*, more so than Methyl groups. Another interesting difference between Ethyl and Methyl groups is seen in the case of *para*-phenetol-carbamide $C_2H_5O.C_6H_4.NH.CO.NH_2$ (Dulcin) which is intensely sweet and the *Methyl analogue* which is *tasteless*.

Ethyl groupings are seen in the following hypnotics. **Ethyl Alcohol**, Amylene Hydrate, the Sulphonal group, Urethane, Hedonal, Veronal.

Note also the harsh action of Acetanilide is greatly modified by the introduction of the ethyl group as in phenacetin.

Effect of Phenyl Group,—no general rule.

Effect of Hydroxyl Group.—In *aliphatic bodies* the Hydroxyl group usually weakens action and it is roughly proportional to the number of OH groupings introduced, *c.f.*, conversion of the narcotic Alcohols into Glycols, Glycerol, Mannitol, etc.

The effect is otherwise however in the case of the *aromatic bodies*—the OH usually *increases* effect,—*c.f.*, the obvious case of Benzol and Phenol also Benzoic and Salicylic Acids. The OH very often performs the function of an anchoring group, *e.g.*, for esterification.

Primary Alcohols as a generalisation are less active than secondary and these again less active than the tertiary.

Effect of Halogen.—

In *aliphatic bodies* there is *increase in narcotic power*, but there is *also an increase in depressant action* on the heart and blood vessels. The narcotic power and toxicity of Chlorine compounds is well seen in the case of the **Chlorhydrins**,—narcotics and vasodilators derived from **Glycerin** which is inert, Tri-chlorhydrin being most active and the Mono-compound least. Note that in the case of the Trichlor- and Monochloracetic Acid the toxicity is reversed. Halogen introduced in the Benzene nucleus causes little alteration

in properties. Organic Iodine Compounds differ from those of Chlorine and Bromine in having greater antiseptic and toxic properties and diminished hypnotic effects.

Although the entrance of halogens increases the narcotic action of a drug, the molecule acts as a whole, neither Chlorine nor Bromine being set free in the tissues. Examples: Chloral Hydrate, Trichlorbutyl Alcohol.—J. Grier, B. and C.D. i./13,282.

Effect of Nitro- and Nitroso- Groups.

Either of these whether replacing Hydrogen in the nucleus or in an Hydroxyl Group causes *increased toxicity*. The Aliphatic Nitrites are **vasodilators**, *c.f.*, Amyl Nitrite. All the Nitrites act in this way, the secondary and tertiary being stronger than the primary, probably owing to the fact that they are more readily hydrolysed to Alcohol and Nitrite. **Nitroglycerin** and **Erythrol Nitrate**,—Esters of Nitric Acid show similar action. In the *Aromatic Series* a Nitro Group entering also usually *increases toxicity*.

The effect of the sulphuric (SO_4) group is non-permeating whilst the acetic radicle is so, also the ammonium radicle; this explains why ammonium acetate is actively diuretic whereas ammonium sulphate is slightly cathartic.—J. Grier, *ibid*.

Effect of Basic Nitrogen Groups.—This can produce in either series important changes to which P. May makes various references. The introduction of *Alkyl groupings* into such bodies reduces toxicity and as before gives *hypnotic effect*, *e.g.*, Carbamic Acid NH_2COOH (poisonous) gives Urethane (Ethyl Carbamate)—more stable and hypnotic. Hydrazine $\text{NH}_2\text{—NH}_2$ is far more toxic than NH_3 , but the Tetra- and Penta- Methylenederivatives are non-toxic.

The entry of the Amino Group into the **Benzene nucleus** forms the groundwork of a large number of **antipyretics** and analgesics. Aniline like Ammonia produces convulsions, but like Benzene it also causes paralysis of muscles and nerves and if one of the Hydrogen atoms of the NH_2 group be replaced by Alkyl the convulsions disappear but the paralysing action remains. If a Hydrogen atom in the nucleus be replaced by a single atom, *e.g.*, Bromine, the convulsive effect is retained, and if it is replaced by an alkyl group the effect is increased, but if a complex group, especially an acid group, *e.g.*, SO_3H , enters the nucleus, the effect is lost, *e.g.*,

in Amino-Benzene—Sulphonic Acid $\text{C}_6\text{H}_4 \begin{matrix} \text{NH}_2 \\ \text{SO}_3\text{H} \end{matrix}$. All these derivatives *e.g.*, Aniline have a toxic action on the blood, forming Methæmoglobin. As a rule aromatic derivatives of NH_3 *lower temperature*.

Effect of the CN radicle.—Isocyanides (Isonitriles) cause paralysis of the respiratory centre and the Cyanides (Nitriles) produce coma. Neither, however, are as poisonous as HCN. The lower members in the fatty series, CH_3CN and $\text{C}_2\text{H}_5\text{CN}$ are less poisonous

than the higher—Cyanacetic Acid CNCH_2COOH is practically non-toxic. Cyanogen Chloride CNCl on the other hand is very toxic as it yields readily HCN .

Effect of Aldehyde Groups.—

Formaldehyde is very reactive chemically and physiologically. It is a strong irritant on the mucous membrane. Acetaldehyde produces excitation, and then anaesthesia. Paraldehyde is stronger in action than the latter. *By entry of OH* into the Aldehyde molecule and by condensation of these bodies to form Aldols, *reactivity is lowered*, as also physiological power,—the sugar are practically inert. The aromatic Aldehydes are of low toxicity.

Effect of Ketones—Similar to that of Alcohols,—narcotic. A hypnotic action is seen in the Mixed Ketones, *e.g.*, Acetophenone $\text{C}_6\text{H}_5\cdot\text{CO}\cdot\text{CH}_3$.

Effect of Acid Groups. These cause generally a *decrease in activity* or total suppression, *e.g.*, substances containing an OH group on combining with *Sulphuric Acid* lose their toxicity—Phenol is toxic but Phenyl Sulphuric Acid is harmless, *c.f.*, also Morphine $\text{C}_{17}\text{H}_{17}\text{NO}(\text{OH})_2$.—Morphine- Sulphuric Acid $\text{C}_{17}\text{H}_{17}\text{NO}(\text{OH})\cdot\text{O}\cdot\text{SO}_2\cdot\text{OH}$ —this latter, as already referred to, is practically inert. The Sulphonic Acids of various drugs are in nearly every case of little use, the introduction of *Carboxyl* (COOH) is almost analogous. COOH for example reduces toxicity of Benzol which can be taken in doses of 8 Gm. per day to 12 to 16 Gm., of Benzoic Acid. Methylamine NH_2CH_3 is toxic. $\text{NH}_2\text{CH}_2\cdot\text{COOH}$ (Glycine) is harmless. The *mere addition of Acid radicles* without converting the body into an Acid may suffice, *c.f.*, NH_3 poisonous, $\text{NH}_2\text{CO}-\text{CH}_3$ Acetamide practically harmless. Acetanilide is less poisonous than Anilin.

The addition of Acid radicles to active bases is useful in synthesis of drugs,—especially with regard to **acetylation of the NH_2 group**,—to weaken basicity and *retard action*. Acetyl, Lactyl, Benzoyl and Salicyl groupings are used, but the *Acetyl* has advantages over the others.

Practically all *synthetic antipyretic* and *analgesic* drugs contain the *acetyl radicle*. Not only so but it occurs in such naturally occurring pain-relieving drug-principles as aconitine and colchicine.—Grier.

Unsaturated Links. Unsaturated substances are usually more toxic than the saturated. **Allyl Alcohol** $\text{CH}_2=\text{CH}\cdot\text{CH}_2\cdot\text{OH}$ is strongly poisonous, but is not narcotic. **Propyl Alcohol** $\text{CH}_3\text{CH}_2\text{CH}_2\cdot\text{OH}$ is narcotic, but not really poisonous. This relative toxic action is a general property of unsaturated as compared with the corresponding saturated bodies.

Molecular Weight, Isomerism, etc.—

Increase in Molecular Weight in homologous series generally produces *increased toxicity*. Several instances in which **stereoisomerides** differ are given, *e.g.*, Isopilocarpine and Pilocarpine, Maleic and Fumaric Acids, Atropine and Laevo Hyoscyamine,

Dextro and Laevo-Nicotine and the natural Adrenalin which is about 11 to 12 times as active as the Dextro compound. With regard to *ortho*-, *meta*- and *para*- Benzene derivatives, no generalisations can be made. *Para*- compounds are often more poisonous than the *ortho*. (In this connection it is interesting to note that the *para* analogue of saccharin is tasteless.)

With regard to **changes that take place on passing of an organic drug through the system** already referred to, the following is of interest,—*Salts of Organic Acids are generally decomposed into the free acid and a Chloride of the base*, but *Esters* and similar bodies are in the majority of cases *undecomposed* by the *gastric* contents. In the small intestine, however, the drug encounters the pancreatic, enzyme trypsin and an alkaline medium. Trypsin has marked hydrolizing action on Esters, Anilides and similar bodies,—*here after saponification the components of the drug exert their specific action*.—The generally accepted decomposition of Acetyl-Salicylic Acid in the intestine is here pointed out, to which we have devoted some attention, *vide Vol. I.*, p. 87, and *Vol. II.*, p. 11, *et seq.*

Aliphatic bodies suffer usually complete oxidation to Carbon Dioxide, Water and Urea. Aromatic bodies on the other hand maintain the nucleus, the decomposition being concentrated on the side chains.

From the "Chemistry of Synthetic Drugs," by Percy May, D.Sc. (Longmans Green and Co., 1918) By permission of the author.

Sir William Whitla on the **Trend of Thought in Pharmacological Research**. It is not the number or value of the atoms in a compound which we have to think of but the plan of structure by which they are built up and linked to each other in the drug. Of the empirical formula $C_6H_{12}O_6$ there are no less than 66 compounds—all totally different.

Brunton and Cash pointed out that all substances built up on the open chain plan—the types of which are Marsh Gas and Chloroform all paralyse the nerve centres and tend to anæsthetic action whilst the ring series produce convulsions or spasms before paralyzing.

In establishing Ehrlich's chemotherapy—effecting *therapia sterilisans magna*, he was really forestalled by Binz, of Bonn, in 1867. The latter experimenting on the action of various drugs on the infusorial organisms found that active paramecia were readily destroyed by a 1 in 10,000 solution of Quinine, though they withstood enormously stronger solutions of Strychnine and other poisonous vegetable substances. This led to the conclusion (the cause of malaria being unknown at the time) that malaria would be found to be of protozoan nature since malaria was so readily cured by Quinine and, secondly, that in giving 15 grains of the Hydrochloride to an average man a solution of twice the strength in the blood necessary to kill amœbae would be formed, thus fulfilling the *therapia sterilisans magna* idea of Ehrlich.—B.M.J. i./13, 1145 *et seq.*

Pharmacological Action in relation to Chemical Constitution.—C. R. Marshall, P.J. i./13,622. We refer to this paper elsewhere, *e.g.*, under Nitroglycerin and Erythrol, *Vol. I.*

Recent advances in the relation between Chemical Structure and Pharmacological Action.—J. M. Fortescue-Brickdale, B.M.J. i./15, 106; see also Abstracts from this paper in Vol. I. under Potassium Guaiacol Sulphonate and Arsenobenzol.

A review of knowledge concerning compounds of similar constitution in relation to physiological action.—F. L. Pyman, L. ii./17,924.

STERILISATION.

Apparatus.—For the Bacteriological Sterilisation of Pharmaceutical Apparatus—bottles, mortars, measures, pipettes, ampoules, etc., before filling, chemical cleanliness is first necessary. This can be effected by the use of soap and hot water, rinsing afterwards with tap water, then ‘burning off’ with a little Commercial Sulphuric Acid, rinsing again and drying. Bacteriologists find a solution of Potassium Bichromate 6, in Sulphuric Acid 46 and water 30 very useful. The apparatus is then to be heated in a hot (dry) air oven at 150° C. for three hours or at 170° C. for one hour.

The oven should in preference be a jacketed one having air holes in the inner chamber to allow of circulation of the hot air and it should have a thermometer inserted at the top. An oven of this kind may be improvised, but two points are to be borne in mind. (1) Soldered joints are useless. (2) A shelf or false bottom perforated or so arranged for air circulation must separate the articles from the bottom plate, whereon the flame plays. If it be desired to prepare a supply of utensils in this manner, it is convenient to wrap in stout filter paper, cotton wool or lint, *before* placing in the oven, this wrapping remaining on until the Apparatus in question is required for use. In place of the hot air oven a steam steriliser or Autoclave (a steriliser by steam under increased pressure) may be used, as described under ‘Liquids,’ but on the whole dry heat is best.

Ampoules, etc., for Alkaloidal Salts Solutions should first be washed with Dilute Hydrochloric Acid to remove superficial alkali, and then with clean water before sterilising.

Ph. Ital., orders glass ampoules and bottles for hypodermic injections to be tested as follows for alkalinity:—Ten to twelve ampoules or five to six bottles are filled with a clear solution of 1% Mercuric Chloride, and sealed. After half an hour in an autoclave at 112° C. no brownish turbidity should be perceptible.

Dry Chemicals.—The sterilisation of these can best be effected by dry heat,—it should, if possible, be as high as 150° C. and be continued for at least half an hour,—subject, of course, to the physical characters of the substance permitting it (decomposition, M.Pt., volatilisation, loss of water of crystallisation, etc.); or the sterilisation may be done in the ‘autoclave’ at 115 to 120° C. for fifteen minutes, but owing to solubility in the steam many dry substances cannot be so treated—for **Liquids**, however, the Autoclave has many advantages, *v. infra*.

It is convenient in sterilising a bottle full of dry medicament, for example, **Boric Acid Crystals** or a **Zinc Oxide Dusting Powder**, to plug the neck of the bottle with a fairly tight wad of cotton wool (preferably previously sterilised to scorching point in the hot air oven). A supply of this wool should find a place in the Dispensary *kept in a glass jar with closely fitting lid*. The stopper of the bottle is treated separately,—it may be laid alongside the bottle in the oven at the time of heating (ordinary corks are bacteriologically unsuitable). After heating, the bottle and contents are first allowed to cool down gradually—preferably *in the oven* before stoppering,—this ensures that the stopper will not ‘jam.’

It is a good plan to grease the ground surface of the stopper with a minute layer of Soft Paraffin,—this is done *after sterilising and just before inserting into the bottle* (which is effected simultaneously with the removal of the wool plug) by passing it 2 or 3 times through the Bunsen flame. The whole procedure is carried out as dexterously as possible to prevent access of air organisms. (Note, that bacteriologists would burn the exuding portion of the cotton wool plug and quickly blow it out, leaving sufficient to catch hold of—simultaneously allowing the flame to play on the neck of the bottle also).

For sterilisation by dry heat, three hours at 150° C. is adequate or one hour at 170° C. (this latter treatment is sufficient to kill all the usual polluting organisms.)—Muir and Ritchie.—We have modified the time requirement somewhat in respect of Dry Chemicals.

Tawell advises sterilising powdered boric acid by prolonged heating at 98° C. in a carefully regulated air-oven to give satisfactory results. It is liable to undergo change if much heated above 100° C.

Liquids :—

The boiling of a liquid for five minutes is, according to these bacteriologists, sufficient to kill ordinary germs if no spores are present. The boiling of any fluid at 100° C. for 1½ hours will ensure sterilisation in almost any circumstances.

The sterilisation of Liquids may well be done in flasks or other vessels that will stand the heat. Flasks containing liquids plugged with wool as above may be boiled over a Bunsen flame with intervening wire gauze.

To ensure the killing of spores it is customary to heat liquids where spore contamination is likely (spores of the Tetanus Bacillus, Anthrax Bacillus, and the ubiquitous B. Subtilis, the Hay organism) in an ordinary steamer on three successive days (¼ to 1 hour). By this treatment all bacilli present are killed on the first day ; spores present may develop and are killed on the second day, and the third day is to ensure absolute sterilisation,—this is a modified ‘Tyndall’s Intermittent Sterilisation.’

The Spores of the Hay Bacillus are not killed by boiling for about ten minutes (M. and R.).

Some flint bottles (even ‘Winchesters’) will stand treating in this manner and are more convenient for subsequent transit than flasks. A stoppered bottle should be used.

The subsequent ‘stoppering’ of a bottle of this kind is conducted as described under ‘Dry Chemicals.’ Smearing with Soft Paraffin

is essential to prevent subsequent sticking. Working on these lines it is quite easy to bottle off liquids (*e.g.*, Broth used in bacteriological work) prone to rapid bacterial decomposition in such a way as to keep good for years,—indeed indefinitely. Rubber corks are also applicable,—these must be boiled before use.

It is an advantage to heat Solutions in a suitable **Steam Steriliser** for under pressure practically no evaporation takes place from the Solution, as it is surrounded by an atmosphere saturated with water vapour (quite apart from this, steam sterilisation in general is more efficacious than dry heat). The temperature employed in an autoclave is usually 115 or 120° C. To boil at 115° C. water requires a pressure of about 23 lbs. to the square inch (*i.e.*, 8 lbs. + the 15 lbs. of ordinary atmosphere pressure). To boil at 120° C. a pressure of about 30 lbs. (*i.e.*, 15 lbs. + the usual pressure) is necessary. *These pressures would usually be called 8 lbs. or $\frac{1}{2}$ atmosphere and 15 lbs. or 1 atmosphere respectively.* In an autoclave of this kind the desired temperature is maintained by adjusting the safety valve so as to blow off at the corresponding pressure.

Cautions:—In all cases it is necessary to allow the Autoclave to cool well below 100° C. before opening, otherwise there will be a sudden development of steam when pressure is removed and fluid will be blown out of the vessels under treatment. Some Autoclaves are not fitted with a thermometer,—in this case expel all air contained initially, otherwise a mixture of air and steam being present the pressure read off the gauge cannot be accepted as an indication of the temperature. Furthermore care must be taken to ensure the presence of a residuum of water when steam is fully up, otherwise the steam is superheated and the pressure on the gauge again does not indicate the temperature correctly.—M. and R.

A single exposure of 15 minutes in an Autoclave is sufficient to destroy all bacilli and spores, provided the steam pressure is at least two atmospheres, i.e., temperature 120° C. approximately—or 15 lbs. pressure on the gauge.

We now come to the question of **low temperature sterilisation** and take the bacteriologists already quoted as our authorities for the view that '*few ordinary organisms in a spore-free condition will survive a temperature of 57° C. if long enough applied* ; Hence **Solutions or preparations which will not stand boiling** can be rendered practically sterile by heating in a water bath on three successive days at about this temperature—60° to 70° C. is commonly used. The object here is to kill off Spores on the same lines as before and such procedure will obviously kill off the non-spore-bearing pathogenic bacteria.

We have recently found 10 days intermittent heating in this way insufficient to kill B. subtilis spores.

Special Remarks.

Hypodermic Injections and other Solutions of Organic Compounds :—

Suspensions or Emulsions of Chemical Substances decomposed by heat, *e.g.*, **Emulsio Iodoformi**, may be prepared by *first sterilising the suspending medium, cooling and then preparing the suspension in a sterilised mortar*,—the same remark applies to Hypodermic

injections of decomposable substances in 'Vegetable Oils.' The Ph. Ital. directs that ordinary Hypodermic Solutions are to be sterilised at 160° C. for 30 minutes or by heating in an autoclave.

According to this Pharmacopœia—Solutions of substances which are decomposed by a temperature of more than 100° C.—viz., Cocaine Hydrochloride, Morphine Hydrochloride, Atropine Salts, Quinine, Eserine Sulphate, Strychnine, Adrenalin, Cacodylates, and Stovain—are to be prepared with Sterile Water and the container then placed in a water-bath for fifteen to twenty minutes, so that the level of the boiling water in the bath corresponds to that of the solution in the bottle. Solutions of *substances decomposed at about 100° C.* are exposed to a temperature of 58° to 60° C. for one hour daily on four consecutive days. This applies to Serums, Organo-Therapeutic Preparations, Ergotin, and Glycerophosphates. Oily Suspensions of Calomel, Yellow Oxide of Mercury, Lecithin, and Camphor are to be prepared with sterile materials, then placed in a boiling water-bath for ten minutes or in an air-bath at 100° C.

See also **Morphine Injection for use in War**, Vol. I., p. 546.

Note.—We do not agree that all the first mentioned are decomposed as stated at a temperature of more than 100° C.—W. H. M.

Ophthalmic Solutions.—

Remarks under Apparatus and Hypodermic Injections apply here. In dispensing simple Ophthalmic Solutions required for immediate use, *e.g.*, **Atropine**, **Cocaine**, etc., **Solutions**, in Chalk's Dropping Bottles it will be only practicable to thoroughly steam the measure, bottle, rod, etc., and prepare the Solution by dropping the Alkaloidal Salt into the bulk of the required amount of hot water or other diluent—making up to volume on cooling. *Note.*—Cocaine, Atropine and Eserine Salts are *not* decomposed by this procedure. *N.B.*—*A supply of Chalk's Bottles sterilised by steam and wrapped in Filter paper should be kept ready in the Dispensary.*

Ointments may be sterilised by shaking melted ingredients in a closed tin until cold. In the case of Ointments containing ingredients decomposed by heat it will be necessary to sterilise the non-decomposable items (*i.e.*, presumably the basis), and to incorporate in a sterile mortar with the decomposable items. In some cases the latter may be sterilised by shaking with Alcohol and subsequently with Ether if insoluble in these two liquids.

Plasters.—

To sterilise a plaster mass the ingredients separately may be heated so far as is possible. A germicide is then incorporated with the mass which will not affect the skin when the spread plaster is applied. A mixture of thymol and methyl salicylate has been recommended, 0.4% of the former and 0.6% of the latter substance added to rubber plaster has been found quite satisfactory. The addition of 1% of phenol to the isinglass solution is useful for court plaster. Plaster wound on spools leaves very little of its surface exposed to the air, and is therefore the least liable to infection.—Pinchbeck, P.J. ii./07, 122.

Surgical Instruments.—In boiling these (knives, forceps, etc.) to sterilise it is customary to employ a solution of Sodium Carbonate—about 1% is adequate. It is claimed that this prevents rust formation, *c.f.* Vol. I, p. 704.—R. R. Bennett and W. G. U. Woolcock on Sterilisation in Pharmacy, *vide* P.J. ii./09, 420, 491.

Recent experience in the war is, however,^r that it is better to boil instruments in air-free (boiled) Distilled water to prevent rust.
—W. K. Fitch.

Surgical Dressings :—

For sterilising Surgical Dressings, the Dressings may well be wrapped in Cotton Wool or in cloths or towels. They are sterilised by superheated steam in a steriliser. (For purposes of transmission and to ensure satisfactory keeping properties the Dressings may be packed in tins.) The air is then exhausted at 20 ins. pressure ; steam at $260^{\circ}\text{F.} = 126.6^{\circ}\text{C.}$ is introduced, and is forced through the Dressings for 20 minutes. The Dressings are finally exhausted by reduced pressure (vacuum of 20 ins.) for 20 minutes and on removal rapidly soldered down. 'Dressings Boxes' are also used with holes in the sides which allow of passage of steam through the Dressings—which are closed instantly on removal—soldering is preferable.

Failing access to a steam steriliser the Dressings wrapped as above may be heated in a current of steam for $1\frac{1}{2}$ hours.

The **Vacuum producing** arrangement in large sterilisers for this class of work ensures the subsequent thorough penetration of steam into the interior of the Dressings and on completion of the sterilising the steam is completely removed by the re-exhaustion. The Apparatus as made by the best Manufacturers is provided with an **air filter** to contain Cotton wool or other medium, through which the air is drawn into the chamber at the close of the operation.

The heating of Sterilisers of this description is done either from an existing or separate steam boiler, or by gas burners, or oil burners, or by combination supply alternately, *e.g.*, steam and gas, oil and gas, oil and steam, as occasion requires. In this way, except in the first case, the Steriliser may, if desired, be worked by steam from an absolutely pure source, *e.g.*, Sterilised Distilled Water.

For testing the efficiency of sterilisation the Tubes Témoins, p. 1, (this Vol.) are convenient.

Sodium Bicarbonate.—To sterilise a 5% solution (much used in place of normal saline) it is best to steam in a Koch steriliser. Boiling at ordinary atmospheric pressure causes considerable decomposition.—E. J. Hart, P.J. i./19,59.

Quinine Acid Hydrochloride may be sterilised at 115°C. in an autoclave for 15 to 20 minutes.

A list of temperatures suitable for a variety of chemicals is abstracted.—P.J. i./19,34.

IONTOPHORESIS.

Syn. KATAPHORESIS, MEDICAL IONISATION.

In the dissociation of a molecule of a substance—inorganic or organic in solution—the nascent particles of the elements are called 'ions.' They are charged with electricity and are in rapid motion. The + charged are called 'Kathions' and those charged 'Anions.' Various agencies in addition to electricity are capable of causing the

splitting up of compounds with the formation of ions, *e.g.*, heat, light, and Röntgen Rays. Dilute solutions of substances contain free ions of the substances. Dilute Hydrochloric Acid can be electrolysed (split up) into its constituents Hydrogen and Chlorine which in their ionised condition appear at the poles of a battery, the Hydrogen at the **Kathode** (negative pole) and the Chlorine at the **Anode** (positive pole). On reaching their respective poles they lose their existence as ions. Arrhenius views that all solutions capable of conducting electricity contain molecules *already* dissociated.—*c.f.* Newth.

When zinc and copper plates are in contact, *e.g.* by a wire, in dilute sulphuric acid, electricity passes across the junction from copper to zinc and then from zinc through the exciting liquid to the copper again.

The galvanic current passes through some conductors with little difficulty—silver and copper for instance, if pure and moderately thick, have extremely little resistance, whilst others, *e.g.*, Platinum and the element Carbon, especially if of very small cross section, cause a considerable amount of resistance and *ergo* heat—this in the case of Platinum is used in the galvanic cautery, whilst Carbon is employed to restrain current—*i.e.* as a rheostat.—S. Sloan, L. ii./II, 1761.

Non-Electrolytes are substances not capable of conducting electricity, *e.g.*, pure water, aqueous solutions of Alcohol or Sugar, Benzene, and a large number of Organic Compounds which do not fall under the head of salts, acids or bases. Nitrobenzene, Ethyl Nitrate, Chloral, are not electrolysed. Furthermore, Glycerin, Chloroform Vaseline do not dissociate electrolytes (*c.f.* the relative non-toxicity of Glycerin of Carbolic Acid). Leduc points out in particular that a 5% Aqueous Solution of Phenol applied to an ulcer of the leg as a permanent dressing may prove most serious, whilst an Ointment of the same strength will make an excellent dressing. Carbolic Acid and Glycerin, equal parts, can be injected into purulent foci providing water be avoided. In aqueous electrolytic solutions the + and – ions are equally diffused, the + electricity of the one (metals) exactly neutralising the – of the other.

The *Electrolytical Solution pressure*, *i.e.*, tendency of different metals to become ionised when in contact with a liquid varies with different metals, *e.g.*, in the case of:—

Zinc, Iron, Lead, *Hydrogen*, Copper, Silver.

The metals on the left have electrolytic solution pressure greater than H and those on the right. The former deprive H ions of their positive charges and thus displace H in an electrolytic cell. They dissolve in acids with evolution of hydrogen. In the voltaic cell of Zn, Cu and H_2SO_4 , the Zn by its high Electrolytical Solution pressure tends to form + charged Zn ions, and in doing so becomes – charged, the Cu has almost no tendency to become ionised and acquires a positive charge.—Lewis Jones. In addition to these two classes Newth mentions a class midway termed half-electrolytes. The terms strictly apply to the actual liquids or solutions—it is, *e.g.*, the *aqueous solution* of sodium chloride which is the electrolyte, but for brevity it is cus-

tomary to understand that *an aqueous solution is intended* and to speak of Sodium Chloride as an electrolyte, sugar as non-electrolyte, etc.

Paul and Krönig in 1896 found that solutions of various antiseptics containing toxic ions in the same proportion are equally antiseptic. One gramme-molecule in 64 litres of either Mercuric Chloride or Bromide is more powerful than Mercuric Cyanide solution four times the strength, as Mercuric Cyanide undergoes less dissociation.—L. i. /07,523.

In Kataphoresis—introduction of medicaments into the tissues by ionisation—a movement of the electrolyte, comparable with Osmosis, takes place under the current generally in the direction of its flow, *i.e.*, from + to — pole. Fluid can in this way be made to pass through porous diaphragms, *e.g.*, the skin, but the migration of the ions is a more important consideration.

The Kathions (+ charged) travelling to the Cathode include H, Na, K, Li, Pb, Cu, Fe and Bi.

The ions of alkaloidal bases in solutions of their Salts are also set free at the positive pole and are therefore applied medically at the Anode. (Positive Pole.)

The Anions (— charged) carry this electricity to the Anode. They include most of the metalloids and non-metals, also the following groupings—OH, NO₃, ClO₃, C₂H₃O₂, SO₃, C₂O₄, PO₄.

These must, therefore, be introduced for medical purposes under the Kathode. (Negative Pole.)

The name 'ion' (a traveller) was given to these by Faraday. The Anions travel *against* (sometimes called *up*) the current, the Kathions *with* (sometimes called *down*) the current.

The electrical capacity of the ions varies with the valency of the element. The ions of 1 gramme-molecule of hydrogen and all monovalent elements carry electricity equivalent to 96,550 Coulombs. Divalent ions carry twice the quantity and so on.

Kathions. MONOVALENT OR UNIPOLAR KATHIONS :—

H, NH₄, K, Na, Li, Ag, also Hg(ous) and Cu(ous).

DIVALENT :—

Mg, Ca, Fe(ous), Ba, Sr, S, Zn, Pb, also Hg(ic) and Cu(ic).

TRIVALENT.—Fe(ic), Al, Bi and Sb.

Anions.—MONOVALENT.—OH, F, Cl, Br, I, NO₃, ClO₃, C₂H₃O₂, and the Anions of all Monobasic Acids.

DIVALENT.—SO₄, SO₃, S₂O₃, CO₃, S (Sulphide), C₂O₄ and all anions of dibasic acids.

TRIVALENT.—PO₄ and other anions of tribasic acids.

The neutralising power is dependent on the valency, *e.g.*, a trivalent Nitrogen Anion requires three monovalent Hydrogen Kathions for neutralisation. The halogens, as also Carbon, Sulphur, and Phosphorus show a variable valency.

The more a solution is diluted—up to a point—so much greater is the ionisation and rate of molecular conductivity.

Osmotic pressure is influenced by ionisation. It is in proportion in the case of electrolytes to the molecules plus ions in the solution. In the case of non-electrolytes the osmotic pressure is only proportional to the number of molecules.

Ionisation of atoms giving them energy of various kinds appears according to an interesting standpoint taken up by Tibbles, to indicate to some degree an intermediate stage between living and non-living matter. Living organic

matter from (inorganic) Carbon, Hydrogen, Oxygen, Nitrogen, &c., is the outcome of (ionic) biological changes. Ionisation, in his opinion, brings about the 'continuous adjustment of the internal relations of materials to the external relations,' the 'transformation of energy' and other forms of change.

The **rate of absorption** of Salts through animal membranes has been found to differ according to the proportion of contained ions. K, Na, and Li were absorbed about equally. NH_4 and Urea were absorbed more rapidly, Ca more slowly, and Mg slowest of all.

Of the Anions Cl is absorbed most rapidly, then Br, I, NO_3 , SO_4 in this order.

The **taste** of substances has by some been thought to be due to dissociation, *i.e.*, to the action of Ions on the tongue or nerve endings—*e.g.* the H ions in the case of Acids. Richards (Amer. Jl. Chem. 1898, xx., 121—126) points to the fact that a Hydrochloric Acid Solution of distinct acidity to the tongue is tasteless when neutralised by Potash.

A small amount of Sodium Acetate added to a dilute solution of Hydrochloric Acid diminishes its acid taste. This view is debated however (*v.* Tibbles, p.

Ions in many cases are toxic to low forms of life. Cl, Br and I increase this respect slightly with their atomic weights. The anions of Mineral Acids have slight toxicity for fungi. Those of HCl, HNO_3 and H_2SO_4 being less than $\frac{1}{3}$ of that of H Ions. From some experiments by Osborne (Proc. Phys. Soc 1905) it was thought that Sodium Ions are toxic and Calcium Ions antitoxic.

Crystalloid substances are either electrolytes or non-electrolytes—the former constitute the Salts, Acids and Bases—the latter consisting mostly of organic substances such as Sugar or Urea. They readily pass through animal membranes as already described, p. 346, and have a strong affinity for water. Their ions play an active part in the well-being of the organism.

The Mineral Constituents of the human body in the concentration in which they are present are almost completely dissociated—the remaining molecules (undissociated) are neutral electrically.

Colloid substances *c.f.*, p. 346, do not pass through animal membrane and their osmotic pressure is so low that they diffuse with utmost difficulty. Tibbles gives the name **Meres** to the particles in a colloidal solution (Merus, Latin = real, pure, that with which nothing is united.) They possess energy, part of which is potential and part kinetic, by reason of their electrical charge, their chemical combinations, etc. In colloidal bodies such combinations appear to be always between ions and meres—to such are due many physiological processes.

Change from colloid to crystalloid in the organism and *vice versa* is continuously proceeding.

All crystalloids have the power of modifying the gelation of colloids, but only the electrolytes have the power of precipitating them. The precipitating power of the electrolytes varies. Mg, NH_4 , K, Na and Li increase in power of precipitation in this order, but the anions—Sulphate, Phosphate, Citrate, Tartrate, Chloride, Bromide, Iodide, and Sulphocyanate inhibit the action of the metallic ions, and the power to prevent the precipitation of Proteins also increases in this order. Thus the Sulphates increase in precipitating power from Mg to Li, and on the other hand Sodium Salts decrease in precipitating power from Sulphate to Sulphocyanate in the order given.

In the living organism it is well known that the salts are held fast with great force, and this is an analogue of the affinity exhibited between the salts and the Proteins. According to Pauli all the Protein constituents of the protoplasm enter into the composition of this substance only in combination with ions.

Leduc is of the opinion that there is no sharp limit between solutions of crystalloids and colloids—all properties of the one are found in the other—the difference is only in degree. Colloids have enormous molecules, *e.g.*, those of Albuminoids, and hence their solutions have a feeble molecular concentration and feeble osmotic pressure.

The importance of acquiring knowledge of the osmotic pressure of the fluids of the body is evidenced in every day treatment, *e.g.*, in the use of 'Normal

Saline Solution.' Application of pure water causing osmosis in mucous membranes is painful and the use of a too concentrated Saline Solution will cause blood corpuscles to part with their water and break up completely.

The readily diffusible substances Urea, Sugar, etc., are produced by decomposition of Protein or Carbohydrate during metabolism—these are fortunately non-electrolytes, they are ionised only very slightly or not at all—this is of the utmost importance to the organism.

All *Kathions* precipitate protein. They increase more or less irritability of muscle and nerve,—they excite intestinal activity and increase blood pressure.

Anions dissolve protein (inhibiting the action of *Kathions* in general). The Sulphates, Citrates and Tartrates precipitate protein because the anions are associated with the over-balancing properties of the metallic ions. They are therefore cathartics. But in the case of Nitrates, Bromides, Iodides, the anion predominates in effecting sedative action and decrease of blood pressure.

The cathartic and precipitating power run parallel in the previous type of substances.

Application of Ionisation Medically.—

The introduction of medicamenta by ionisation brings about a substitution of the fresh ions for the ions of the organism. This may obviously be a more drastic procedure than introducing chemical substances by the stomach or subcutaneously, hence caution is necessary both as to the purity of the substances, the strength of current used, and method of procedure.

Ointments and pomades, in many cases, act only superficially,—by iontophoresis one may introduce ions to the 'very spot.'

Ionic Medication has many advantages:—Easy application; Localisation and duration of treatment; Use of nascent particles of elements and atom-complexes; Relative painlessness. For further details see the Summary of References, later.

Electrical Medication was originated by Fabre Palaprat, in 1833—who wrote on the introduction of Iodine into the tissues.

The quantity of drug caused to penetrate is strictly proportional to the magnitude of current and the duration of its flow.

The Solution made of the strength desired (e.g., with a '**Solube** or '**Sterule**' for **Ionic Medication**,) is applied by means of a disc covered with a pad of a number of thicknesses of Lint or Absorbent Cotton Wool, or by a **glass cup electrode**. This, the *active* electrode, is covered with a piece of pig's bladder, which is capable of allowing the ions to pass. The *indifferent* electrode is applied in any convenient situation.

The Unit of Electromotive Force is the *volt*. Resistance of a conductor is stated in *ohms*. Strength of Current is expressed in *ampères*. The *ampère* is the Current which an E.M.F. of 1 *volt* produces in a circuit where the resistance is 1 ohm,—for medical use the 1/1000 part, the *milliampère*, (*m.a.*) is the Unit or Standard. It is measured by D'Arsonval's Milliampere-meter.

The *Coulomb* is the unit of quantity of current—it is delivered by a current of 1 *ampère* in 1 second.

The density of the current used $\frac{I}{S}$ (intensity divided by surface of the conductor) is of great importance in medical use. 100 *m.a.* introduced into a patient by a surface of 1 sq. cm. will produce a different effect from the same current traversing 100 sq. cm.—as could easily be imagined, each sq. cm. in the last case being traversed by 1 milliampère in place of 100.

Electrical Energy or the power of doing work is measured in *joules*. One joule represents the energy expended in one second by one ampere with resistance of one ohm.

Strength of Current used :

One requires for ionising about 40 to 50 volts, which with a total resistance of 400—500 *ohms* will produce a current of 100 milli-ampères.

$$I = \frac{E}{R} = \frac{50}{500} = 0.100.$$

(Ohm's Law : Intensity of Current is equal to E.M.F. divided by the Resistance or $C = \frac{E}{R}$).

This may well be provided by 30 cells having an E.M.F. of about 1.5 volts joined up in series.

A current of 30 to 40 *m.a.* as a minimum, 50 to 70 *m.a.* as an average and 100 to 150 *m.a.* as an exceptionally strong one may be taken as a rough index of the current to be used in the treatment of a large joint, such as a knee, with Salicylic ions, which require a stronger current than most other ions. In the case of the last strength a quarter of an hour ought to be occupied in reaching this. If the ions are penetrating into the tissue, the hand of the milliampèremeter will be noticed to gradually rise and then become stationary, but should the hand be seen to recede—this will signify that the ions are not penetrating properly, but are gathering on the surface and forming a resistance to the current. Abrasions of the skin should be first covered with a small piece of some non-conductor before applying the electrode.—Lewis Jones. L. ii./11,374.

Resistance of the Body may be calculated by Ohm's Law from the galvanometer reading and the electromotive force of the cells—*e.g.*, with 6 Leclanché cells the E.M.F. being 9 volts, if the current through the patient be 4 milliampères, the resistance may be found thus :—

$$R = \frac{E}{C} = \frac{9}{0.004} = 2,250 \text{ Ohms.}$$

In employing the continuous current from the electric mains in place of batteries or accumulators secondary circuits of high resistance are required by which the potential gradually changes

The following table will be found useful :—

TABLE SHOWING THE RELATION BETWEEN THE VOLTS USED AND THE NUMBER OF MILLIAMPERES of current resulting with various Resistances in Ohms of the Body.

Ohms resistance of the body =		100	300	500	750	1000	1500	2000	2400	3000	4000
No of dry or Leclanché cells used.	Volts.	Milliamperes.									
		1	2	3	4	5	6	7	8	9	10
1	1½	15	5	3	2	1½	1	¾	⅝	½	⅓
2	3	30	10	6	4	3	2	1½	1¼	1	¾
3	4½	45	15	9	6	4½	3	2¼	1¾	1½	1¼
4	6	60	20	12	8	6	4	3	2½	2	1½
6	9	90	30	18	12	9	6	4½	3¼	3	2¼
8	12	120	40	24	16	12	8	6	5	4	3
10	15	150	50	30	20	15	10	7½	6¼	5	3¾
14	21	—	70	42	28	21	14	10½	8¾	7	5¼
16	24	—	80	48	32	24	16	12	10	8	6
20	30	—	100	60	40	30	20	15	12½	10	7½
24	36	—	120	72	48	36	24	18	15	12	9
28	42	—	140	84	56	42	28	21	17	14	10½
32	48	—	—	96	64	48	32	24	20	16	12
40	60	—	—	120	80	60	40	30	25	20	15
50	75	—	—	150	100	75	50	37	31	25	18½
60	90	—	—	—	120	90	60	45	37	30	22½
67	100	—	—	—	132	100	66	50	41	33	25

By the above table the Resistance in Ohms of any part of the body, is found by noting how many *m.a.* are registered with the voltage used.—R. Edwards.

Differences between "Electrolysis" and Ionic Medication.

Electrolysis and Ionic Medication must be separated in their therapeutic aspects. In electrolysis the object is to utilise the effect of the ions when they *reach the electrode*; in ionic medication it is the ions which *leave the electrode* that are utilised in treatment. In ionic medication the ions pass right through the tissues into the protoplasm of the cells.

In electrolysis if astringent and caustic effects are desired the *positive* electrode must be applied. If softening and breaking down are wanted the electrode applied, at the *negative* pole must be the active one. In either case the *effect is due to the ions of the tissues, not to any extrinsic ions.*

In ionic medication on the other hand, it is much more a question of the *chemical to be employed* and the pole to be used is determined by the electric charge on the ions to be utilised.

In electrolysis a non-electrolytically soluble electrode is used such as Platinum or Carbon, in ionic medication the electrode is the substance whose ions it is intended to introduce where this is possible. S. Sloan.—L. ii./11,1762; B.M.J. ii./12,491.

In arthritis and sciatica benefit from iontophoresis is more likely due to the interpolar migration of the normal ions of the tissues than to the bodies used locally. The mere passing of the galvanic current will bring from the kathode side of the Calcium Zone the phosphoric acid ion which will dissolve the Calcium precipitated in the tissues—flushing the part affected.—S. Sloan, B.M.J. ii./12,489.

Summary of Various Chemicals Employed by Ionisation, with References to their Uses.

The following is a short *résumé* of the Chemicals used and the results obtained by Kataphoresis. The medicament is carried through the tissues of the patient who is situate between the two poles. One may regard the human body, from the iontophoresis standpoint, as a solution of sodium chloride, and as the positive ions, *i.e.*, metals, etc., enter from the anode they displace some sodium ions, which emerge under the cathode. Again, as negative ions, *e.g.*, iodine and bromine, penetrate under the cathode, they displace chlorine ions which appear at the anode. The list is not intended to be exhaustive; other substances suggest themselves.

Leduc pointed out that using simple weak acid solutions the effect on the skin at the anode by the H ion is the same for all ordinary acids. Using dilute alkaline solutions one introduces OH ions at the kathode. In each case the sore produced by a long or strong application has its own characteristics. The K or Na or Mg ions produce definite effects only when given in large amounts. The alkaline earth metals, however, produce characteristic destruction of the tissues. He instances effects obtained when using Calcium Chloride solutions—the surface at the anode seemed white as though impregnated with Calcium Carbonate or Sulphate. Œdema occurred and an indurating ulcer was formed.

Of all ions the most painful was that of Carbonic Acid.

Sulphuric Acid produces a smooth, hard, dry skin surface.

As already outlined, the + ions (basic radicles) in a solution under going electrolysis travel from the positive pole towards the negative, and the – ions (Acid radicles) move away from the – pole. If we imagine the patient separating the solution into two parts with 1 pole of the battery in each part the – ions will pass into the patient to make for the + pole, and the + ions will be passing from the other side. These new ions displace those already in him (of the same electricity), these in turn displace more, and at his opposite side some of his own ions pass out into solution. The solutions can be different at the poles; one may at one time have Potassium Iodide on the – pole driving in Iodine and Sodium Chloride on the + pole introducing Sodium.—L. i./09,756.

Oily applications must be removed before treatment, as they are non-conductors of electricity.

Pure Water is a non-electrolyte—it contains practically no ions. A table gives the No. of *m.a.* obtained on passing a current of

50 volts through various concentrations of Salt in solution, *e.g.*, starting with a saturated Salt solution.

36%	..	..	current	600	<i>m.a.</i>
18%	..	..	current	575	„
2.25%	..	..	current	240	„
1.125%	..	..	current	140	„

Each dilution, *i.e.*, gives indication of containing more free ions than would be expected from the amount of the dilution—especially in the stronger solutions. This relationship diminishes as the dilutions increase until a dilution of about 1% is reached. By this time practically all the molecules have become dissociated, and in further dilutions the amount of current is practically directly proportional to the amount of concentration.—S. Sloan, L. ii./11,1759; *vide* also Sodium Chloride.

Copper chain-mail electrodes are useful, gold or platinum would be better. The latter should in particular be used with organic substances.

Details as to technique, for large electrodes, of about 50 square inches. Copper Gauze is used, having a covering of moist sculptors' clay and lint.—L. i./10,353.

A gilt wire gauze with fine meshes sold for trimming ladies' hats under the trade name of **Tricotine**, forms an excellent electrode—another form of electrode is a pot cleaner made of strands of copper wire.—L. ii./11,373.

Solutions for Ionisation must be made with utmost care with fresh distilled water. Materials should be washed in the same. Whenever possible the metal of the anode should be the same as that of the electrolytic solution:—

Acids, whether for introducing the positive (Hydrogen) or the Hydroxyl (negative) ions should be used in 1 in 1,000 solution.—Ledue.

Cauterisation of the glands of the skin can be shown under the anode by the penetration of the H ion.—*c.f.* Hydrogen Ions.

Acid Monochloracetic $\frac{1}{2}$ % with Sodium Chloride 1% used by iontophoresis in gonorrhœa, 2 to 3 *m.a.* for $\frac{1}{2}$ hour. Results successful.—C. Russ, B.M.J. i./17,616.

Acid Salicylic. *See* Sodium Salicylate.

Adrenalin.—Introduced under the anode produces anæmic lines. These and 'an ivory whiteness' indicate the vascular absorption.

Alkaline Earth Metals, produce mortification of tissues, *vide antea*.

Alum.—Ionisation with 2% solution useful in relaxation of the tympanum.—L. Kesteven, B.M.J. ii./17,423.

Ammonium Ions, no therapeutic effect, but used where no effect is required from the positive ions.—L. i./09,757.

Aniline as Hydrochloride has been used in lupus.—B.M.J. ii./08,1180.

Antiseptics, Powerful, can be introduced to whatever depth may be required.—Ledue.

Arsenic acts as a vaso-constrictor of the skin vessels. This is made use of in the Arsenic ionic treatment of psoriasis; a solution of arsenious acid 1 in 200 is introduced on the Kathode every second day for 10 minutes.—Hospital, 1910, April 30; B.M.J. ii./12,489.

Bases applied under the Kathode show the cauterisation of glands by the penetration of the OH ion.

Bromine Ions have well marked sedative action.

Butyric Ions have been suggested in lupus.—B.M.J. ii./12,489.

Calcium Ions are found to be deposited in and beneath the corium, only a small quantity going through the latter even when a large current is passed for a long time.—N. S. Finzi, B.M.J. ii./12,1181.

Chlorine *vide* **Sodium Chloride**.

Chromic Ions might be used for the conditions in which Chromic Acid has hitherto simply been painted on.—B.M.J. ii./12,489.

Cocaine (from the positive electrode) using a solution of the Hydrochloride 5 to 10% strength—the skin sensibility is abolished in 10 minutes; has given speedy relief of pain in tabes dorsalis (Gowers).—B.M.J. i./05,5. Suitable for minor surgery.

The following solution has also been advised.—Cocaine Hydrochloride $1\frac{1}{2}$ drachms, Solution of Adrenalin (1 in 1,000) 2 drachms, Water *q.s.* to 2 ounces.—L. i./07,900. No toxic effects have been observed. Useful for hæmorrhoids.

Cocaine administered in this way, the Cocaine Solution at the + pole and Sodium Chloride solution at the — pole gives a different effect to that by hypodermic injection. The anæsthesia is not diffused—it remains limited to the surface covered by the electrode. The ion appears to be introduced into the cell plasma, not into the circulation. There is at first a blanching followed by vasomotor paralysis, which gradually disappears, giving in a few weeks a pigmented spot persisting several months with a marked atrophy of the skin of the part.

Anæsthesia produced in this way is unsatisfactory as the duration is short and there is marked painful hyperæsthesia afterwards.—L. i./09,756. The hyperæsthesia and hyperæmia may persist for some days, and are succeeded by brown pigmentation. The method is considered bad for local anæsthesia.—N. S. Finzi, B.M.J. ii./12,1180.

In removing moles by epilation Cocaine solution 5% electrolytically for 5 minutes is useful.—Lewis Jones.

Copper Ions employing Copper Sulphate solution have proved effectual in ringworm. A copper electrode connected with the positive terminal has been employed in hæmorrhoids.

Experiments showed that Copper Ions are deposited entirely in the epidermis, not even reaching the corium.—N. S. Finzi, B.M.J. ii./12,1180.

Treatment of cases of pelvic disease in women.—L. ii./09,68, 97. Excellent results obtained with Copper and Iodine. Each micro-organism may have its own particular potent ion; Copper for one, Zinc for another, and so on.—*ibid.*

Copper Ionisation (Cupric Chloride Solution 1%) in obstinate discharge. Introduce the cervical and intra-uterine electrode through the speculum—this ensures asepsis and allows fluid to pass. The current must be reversed for about $\frac{1}{3}$ of the time to obviate pain. In some instances it is well to begin with Iodine, *e.g.*, a solution containing Potassium Iodide 2% and 0.2% Liquor Iodi.—L. ii./09,71.

Local chronic diphtheria of the ear well treated by Cupric Ionisation. Four applications spread over two months.—B.M.J. ii./09, 519.

Trachoma has been treated with Copper Sulphate 0.5% with two to three *m.a.* for two to three minutes every few days. In four acute cases, conjunctiva nearly normal and four chronic cases discharged as cured.—B.M.J. ii./09, 976.

For chronic endometritis recommended.—B.M.J. i./09, 89.

Alopecia areata treated by 2% Copper sulphate ionisation.—Lewis Jones. Lupus erythematosus benefited.—L. ii./08, 391.

In gynæcology the dose of copper ions is given by S. Sloan as equivalent to about $\frac{1}{10}$ grain—this means 1000 millions of millions of millions of ions of copper—these are introduced as bactericides. The fraction of a grain of copper would be capable of introducing into each of a million million millions of *Streptococci* a garrison of a thousand ions with abundance of elbow room for each ion. In uterine hæmorrhage the copper electrode is more potent than the zinc (*q.v.*), but when the patient is very sensitive or there is reason to fear pelvic cellulitis, the bare copper electrode should be avoided.—S. Sloan, L. ii./11, 1761.

During Copper Ionisation the general view is that Copper Oxychloride enters into the tissues,—this is only partly true. The metal becomes lodged in the tissue and is intracellular.—S. Sloan, B.M.J. ii./12, 491.

Rectal cancer treated by copper ions—followed subsequently by zinc ions. Tampon of wool soaked in 2% zinc sulphate solution inserted and the parts covered with 16 layers of lint. The + pole electrode was attached to the pad and the — to the lumbar region. 60 *m.a.* ct. for 30 minutes on alternate days. Astonishingly good result—possibly the long sought for cure for cancer.—M. Wardle B.M.J. ii./19, 495.

Eucaine. Iontophoresis for Anæsthetisation of the gums in dental extractions. The — pole is placed on the side of the head over the position of the Gasserian ganglion. The + pole is then attached to a dental syringe filled with the anæsthetic solution (1% Beta Eucaine with adrenalin) the needle is inserted and solution injected, while at the same time the current passes, carrying the anæsthetic into the tissues—anæsthæsia is said to be much deeper than ordinarily and more complete in effect.—L. ii./11, 1343.

Ferric Ions have been shown to be deposited entirely in the epidermis, not even reaching the corium. With Ferrous Ions the appearances are almost identical with those given by Ferrocyanide.

Ferricyanide Ions.—Experiments with, proved definitely that it is possible to introduce ions of this and other substances right down to the bone, *e.g.*, into a knee joint.—N. S. Finzi, B.M.J. ii./12, 1180.

Ferrocyanide Ions. Experiments on a monkey proved that these ions entered the joint.—B.M.J. ii./10, 520. They can be traced through the skin and subcutaneous tissue into the muscles; they are seen in large quantity in the capillaries of the subcutaneous tissue.—N. S. Finzi, B.M.J. ii./12, 1180.

Gold Chloride applied to the skin at the anode causes coloration

Hydrogen Ions cause the tissues to have an affinity for basic stains, hence can be traced in this way.

Hydroxyl Ions (introduced at the positive pole) produce reverse effect of Hydrogen Ions—the tissue under the ionised patch fails to take basic stains.—N. S. Finzi, B.M.J. ii./12,1181.

Iodine Ions lower blood pressure, influence metabolism of the thyroid and reduce inflammation.—Tibbles.

As a sclerolytic agent, especially for ankylosis following septic arthritis, but *N.B.* short 'seances' desirable as it is likely to be caustic—produces cauterization and pigmentation of the glands.

Iodine may be driven into the thorax using Sodium or Potassium Iodide on the lint and applied with the *cathode* to the part, using a current of 60 to 100 *m.a.*—in ankylosis, neuralgia, etc. Administer with care to prevent burning.

Arthritis deformans well treated by kataphoresis of Iodine in form of Iodine liniment.—L. ii./o8,1869.

In gynæcology when the affection partakes at all of a subacute nature iodine is useful to begin with. Use a carbon electrode. A solution of 2% Potassium Iodide with 0.2% Liquor Iodi is used—where there is inflammation of the tubes, the ovaries or the cellular tissue, if no suppuration is present, the iodine ion gives good results—combined with H. F. current.—S. Sloan, L. ii. /11,1764.

Lupus treated by nascent Iodine. Sodium Iodide is first given in large dose. The patient is given (after 1 hour) the — pole of the battery to hold in his hand, while the + pole in the form of one or more fine platinum-iridium needles is pressed into the ear. current 3 to 4 *m.a.*—Berl. Klin. Woch. per P.J. ii./11,748.

Chronic rheumatoid arthritis, fibrositis and allied joint affections by Iodine ions using Lithium Iodide solution 2%—these are better than Lithium ions, and the current should never be crossed to the latter. The joints being connected with the — pole, a boiling solution should be made which will cool to temperature that patient can stand. Raise current gradually to 70 *m.a.* for two knees; employ 40 for one knee.

Keep the spinal cord out of the circuit, prevent sudden variations in current and try to get density of current equal over the parts. 20 minutes daily for four weeks may be wanted in bad cases. Some improve very rapidly. Combined treatment with radiant heat by special apparatus advised.—B.M.J. ii./10,518.

See also Lewis Jones.—B.M.J. ii./11,887. L. ii./11,373.

Lactic Ions—suggested in lupus.—B.M.J. ii./12,489

Lithium.—In rheumatoid arthritis (*e.g.*, in wrists); radiant heat applied (for twenty minutes as a rule and as hot as can be tolerated) followed immediately by 20 minute kataphoresis of Lithium Iodide Solution 2% strength. Drug treatment *per os* in addition extremely important.—B.M.J. i./09,14. See also Iodine Ions above.

For gout and rheumatoid arthritis Finzi finds a Lithium Salt on the positive with Iodine on the negative side of value. Oedema rapidly disappeared.—L. i./09,757, 1457.

Local Anaesthetic *vide* Cocaine.

Magnesium.—Magnesium ions (from the positive pole) using a Magnesium Sulphate Solution 20 grains to the ounce, have given good effects in multiple warts on the hands. Current 5 to 8 *m.a.*—duration 15 minutes if possible.—Lewis Jones.

Ozæna benefitted.—B.M.J. ii./09,1301.

Mercury.—Preparations of Mercury or Potassium Iodide Preparations taken internally have little action on locomotor ataxy. Mercuric Chloride intramuscularly is of benefit however, and will cure. Cases of syphilis treated insufficiently at the beginning—possibly not recognised—produce locomotor ataxy. **Mercurial Salts of Organic Acids** are not dissociated and again Compounds where the Mercury is part of an atom-complex, give no mercurial effect. They may be painless, but at the same time devoid of action as they lack the Mercury (+) ion. Sodium Chloride added retards dissociation and reduces concentration of the Mercury ions, but here by diffusion in the blood and regulating action of economy the dissociation returns to what it would have been without the added Sodium Chloride.

It is much better to use dilute solutions so as to act in very feeble concentration at the point of injection. In place of a 1% Sublimate employ a 1 in 500 or 1 in 1,000 solution, *e.g.*, 5 to 10 Cc. doses of solution of Mercuric Chloride 0.2, Sodium Chloride 1, in Distilled Water 100. The **injection** to be given twice weekly.—Leduc.

Primary syphilis treated by Mercury ions using 2% Mercuric Chloride Solution.—B.M.J. i./14,138.

Mercuric Potassium Iodide.—Mastoid cases can be arrested by ionisation of a solution of Mercuric Potassium Iodide 1 in 500 for periods of $\frac{1}{2}$ hour morning and evening with 5 *m.a.* current.—L. Kesteven, B.M.J. ii./17,423.

Metals, Heavy.—Ions of these are all more or less caustic (probably by coagulating albumin).

Morphine.—Toxic effects can be produced.

Potassium.—Ions like Ammonium. *q.v.*

Potassium Permanganate.—Applied to the skin at the kathode causes brown pigmentation in the tissues,—the Permanganate ion is immediately reduced, producing an Oxide of Manganese.

Pyrogallol.—Lupus said to have been cured.—L. i./09,757.

Quinine Acid Hydrochloride.—Leduc records a case of trigeminal neuralgia, with frequent attacks of pain (convulsive tic), which after all forms of treatment, including the removal of every tooth, although sound, on the side affected, was cured by 1% Quinine Hydrochloric Solution electrically applied.—Lewis Jones, p. 426.

Herpes zoster, especially herpes zoster ophthalmicus, well treated by ionisation of Quinine,—applications being for 15 to 30 minutes with a current of 1 to 1.5 *m.a.* per sq. inch. Neuralgic pains in the neighbourhood cleared up at once. The otherwise intractable iritis disappeared and sensation of the cornea and conjunctiva returned.—Angus McNab, L. i./13,821.

Radium. Radium Bromide solution in a compress at the + pole was driven in and was found in tissues, bone, etc. to a depth of 9 cm.

as long as a fortnight after its introduction—these results being from animals. Nine cases then treated, 8 being subcutaneous neoplasms. Rapid disappearance of pain and diminution in size.—L.ii./11,1371.

Sarcoma of scapula cured. Depth of penetration, 9 cm., established.—B.M.J.E.ii./11,27.

After treatment radium was found in the adjacent skin, aponeurosis, muscular fibre and bone, and also in the urine. Has a sedative effect and causes diminution of certain tumours.—J.C.S.A. ii./11,418.

Salts, Neutral.—With feeble degree of dissociation, which have no direct action on the skin, are used 1 to 5% strength.—Leduc.

Silver Ions have been used for infective cystitis.

In ulcerative colitis benefit has been derived from electric enemata of 0.1% Silver Nitrate Solution. After lavage $1\frac{1}{2}$ pints of this solution are injected through a rectal tube in which is a copper wire connected with the + pole. Large clay electrodes are placed on the back and abdomen, and connected with the — pole. A current of 15–20 *m.a.* is passed for 15 minutes, and repeated from time to time. Zinc Ions also have been used. Both worth trial in mild cases. — D'Arcy Power, Pr. Aug. '09,154.

Sodium Chloride.—Resolving influence on sclerotic and cicatricial formations by a kathodal stream (Cl. ions), using a slightly warm dilute solution (1 to 2%) of this salt, applying the cathode to the affected region. The tissues receive the Cl. ions and part with the Na. ions—the exchange is said to benefit adhesions and cicatricial tissues. Ankylosis of joints recover their mobility without forcing or pain. The anode may consist of a bath for the feet or arms,—for further details see Leduc. Up to 100 *m.a.* 'doses' in several seances is the usual treatment. Rheumatic sclerotitis and peri-sclerotitis yield well.

Complete ankylosis of the fingers was treated by a bath of Sodium Chloride solution, taking the place of the cathode on two occasions $\frac{1}{2}$ hour each, with a current of 30 *m.a.*, with complete recovery of movement.—B.M.J. ii./08,199.

Eye work. Corneal opacities. Chlorine ions with 3 *m.a.* for two to three minutes.—L. i./09,757; Oph., Jan. 1911, p. 20.

Chlorine Ions. Scars after severe burns, operation scars, old ankylosed joints, Dupuytren's contraction. Useful for.—B.M.J. ii./11,887; L. ii./11,374. In employing Chlorine Ions it is not so much a case of introducing a medicament from without as relying on the effect of the current to produce a change in the distribution of the ions of the body. Large currents (70 to 100 *m.a.*) and lengthy application required.—Lewis Jones, B.M.J. ii./12,486.

Dupuytren's contraction treated. The hand is immersed in saturated Salt Solution and current of about 40 *m.a.* passed for 60 minutes. Four cases,—in one only marked improvement.—B.M.J. ii./12,491.

Ionised Chlorine acts as a powerful oxidiser and antiseptic. Chlorine ions soften cicatricial tissue,—the pads used must be thick and well saturated. They are also stated to cure alopecia areata.—Stopford Taylor and McKenna, L. ii./12 1725.

Psoriasis treated by Chlorine Ions and X-rays.—C. E. De Silva, B.M.J. i./18,9.

Scars, painful, of the face, treated by Chlorine Ions (using sodium chloride) effective—better for softening scars than iodides or salicylate.—H. S. Carter and A. D. E. Shefford, B.M.J. i./19,214.

Sodium Ions are like those of Ammonium, *q.v.*

Superfluous hairs, *nævi*, etc., are removed by electrolysing the saline solution of the body, *i.e.*, by producing Caustic Soda at the —pole.

Sodium Salicylate,—For painful pleurisies and intercostal neuralgia, 2% solutions. Pain disappears under the influence of the Salicylic ion. Also good in *tic douloureux* of the face and sciatica. Infective cystitis has also been treated.

In neurasthenia good results have been obtained by using the solution for the frontal kathode, thus introducing the Salicylic ion into the cell plasma of the affected part. Neuralgia following herpes has been effectually treated by Mackenna.

Corns yield to Salicylic ions.

For psoriasis 1% solution has been recommended.—Lewis Jones.

Sciatica treated by Salicylic ionisation, the electrodes being of lead covered with absorbent material. The kathode is charged with 3% Sodium Salicylate Solution, as hot as possible—about 50° C. The patient lies upon the cathode, and the anode is applied to the abdomen, thigh and leg. Current generally reaches 200 *m.a.* Remarkable results claimed.—B.M.J.E. ii./09,83.

Perineuritis and neuralgia of various types, lumbago, sprains and spondylitis deformans; arthritis, gouty and rheumatic. In sciatica successes not brilliant. Possibly for the last mentioned powerful treatment (200 *m.a.* applied for 1½ hours) necessary.—Lewis Jones, B.M.J. ii./12,486.

Acute articular rheumatism. In a case in which both legs were involved large electrodes one metre long and twenty cm. wide were used. These were smeared over with a Salicylic Acid paste. Half-an-hour's sitting was given for each leg every other day. This was repeated. Cure resulted after five days.—B.M.J.E. ii./10,28. See also B.M.J. ii./11,887; L. ii./11,374.

Acute pericarditis. — 2% Sodium Salicylate applied with the active electrode over the precordium and the indifferent electrode on the back. Current 40 *m.a.* for half an hour. Symptoms gradually subsided. Patient was a thin, delicate girl—the thinness of the chest wall hence favourable for treatment. Aceto-Salicylic Acid also *per os*.—B.M.J. ii./13,1205.

Septic compound fractures and wounds treated by ionisation of Sodium Salicylate. First clean the wounds with 4% Sodium Salicylate Solution, then plug and bind up with dressing soaked in warm 8% solution and apply the positive pole of the galvanic battery with a copper chain electrode. Current 5 to 30 milli-amperes per ¼ hour. Good effects. Suppuration cleared away.—R. McQueen and L. H. Boothby, L. ii./15,69.

'Trench Back' treated by Sodium Salicylate ionisation 1% solution, 30 *m.a.* at first, increased to 100. Cures in 3 to 5 applications.—J. D. Sands, B.M.J. ii./15,215.

Multiple neurofibromata of the spinal cord wonderfully improved by Salicylic ionisation.—G. H. Hickling, B.M.J. ii./17,516.

Sodium Sulphide.—For psoriasis 0.5% solution has been recommended.—Lewis Jones.

Strychnine.—Toxic effects can be produced. Note the ions in this case diffuse rapidly, sufficient to produce death in a few minutes.

Sulphide ions.—Attempts to trace the course of these by staining methods, *e.g.*, with Mercuric Chloride, failed.—B.M.J. ii./12,1181.

Sulphuric Ions introduced by a current of 10 *m.a.* for forty-five minutes leaves a dry parchment surface like varnish,—it becomes black and desquamates in three weeks.—Leduc.

Thiosinamin is used in cases of stricture, enlarged prostate and scar tissue.—B.M.J. ii./12,491.

Thiosulphate Ions for sciatica are mentioned by Lewis Jones.—B.M.J. ii./12,489.

Uranium Nitrate.—In rodent ulcer 2% solution ionised. Healing commenced immediately.—A. Clark, B.M.J. ii./12,716.

Zinc Ions.—Antiseptic of the first rank. There is no wound which cannot be disinfected by its use.—Leduc.

Zinc Salts for use in an infected focus, *e.g.*, purulent otitis, should be dissolved in Glycerin or Oils, having a slight degree of dissociation,—washing with water either before or after is to be avoided—so as to produce a slow dissociation of the remedial ions.

Growth of the hair is stimulated by Zinc Ions in feeble doses. Stronger doses may produce death of the tissue.

For coagulating effect—the best coagulating medium known to medicine. For menorrhagia 60—100 *m.a.* with the Zinc Anode for 20—30 minutes. The Zinc is not absorbed.

Endometritis well treated with a uterine Zinc Anode. Infective cystitis has also been treated, also old-standing ozæna.

Rodent ulcer treatment. The Zinc electrode is wrapped in lint soaked in 2% Zinc Chloride Solution. It is attached to the + end of the battery and the negative electrode is soaked in Saturated Salt Solution—applied to nape of the neck—within limits it should be as large as possible. The current is to be applied gradually and cut off equally gradually to prevent shock—2 to 3 *m.a.* for each sq. cm. of surface. A reaction ensues and subsides and healing may be effected in 10 to 14 days. A second application is not desirable until fourteen days after the first. Cocaine may be ionised into the part beforehand if desired.

The zinc electrodes must be covered with two or three layers of lint wetted with a 4% solution of zinc sulphate. A number of such zinc electrodes of different sizes may be kept ready in the solution. These should not be touched with the fingers, as sodium chloride and other impurities may be introduced. The zinc disc is held over the rodent ulcer, the circuit is closed, and the current slowly turned on until a

current of ten *m.a.* is passing. The application is continued for ten to fifteen minutes, according to the thickness of the individual ulcer. Patients can bear up to ten *m.a.* without complaining. The application gives a burning sensation like a mustard plaster. The Zinc Ions seem to remain in the cells of the part for some time. The rate of movement of the ions in such a case is probably less than 1 cm. in 1 hour, the amount of zinc set in movement in an ordinary application of 10 *m.a.* for 10 minutes is about 4 mgr.—Lewis Jones. See also B.M.J. i./11,14,890.

Chronic pharyngitis, ozæna, pustular eczema and hypertrophic rhinitis have been treated by Zinc ions.

Diphtheritic infections of the skin, warts and lupus treated.—Lewis Jones, L. ii./08,391.

Otorrhœa treated by Zinc ionisation. 3 *m.a.* periods of 5 to 15 minutes.—A. R. Friel, L. ii./20,345.

Ophthalmia neonatorum was rapidly cured by everting the lid and applying + electrode consisting of cotton wool saturated with 2% Solution of Zinc Sulphate. The — electrode held in the child's hand. The battery was an ordinary Bichromate Battery giving 20 volts, $\frac{1}{2}$ *m.a.* current for three minutes. Twelve hours after the application the inflammation was subsiding and another application made. Two days later cured.—B.M.J. ii./08,1433.

In eye work corneal ulcers treated by $\frac{1}{2}$ % solution with current 2 to 4 *m.a.* for $\frac{1}{2}$ to 1 minute. In obstinate blepharitis 3 to 5 *m.a.* for 3 to 5 minutes.—Oph., Jan. 19/11, p. 19.

Mooren's ulcer of the cornea well treated. First "cocainise." A loop of Zinc wire covered with absorbent wool dipped in 1% Sulphate forms the + electrode, the — being applied at any convenient place, current : 1 to $1\frac{1}{2}$ *m.a.* 3 to 4 minutes.—Lewis Jones, B.M.J.ii./10,520.

Atrophic rhinitis treated with some success by Zinc ions, using 1 to 2% Zinc Sulphanilate or by use of Argyrol 10%.—L. ii./08,738.

Lupus vulgaris, lupus erythematosus, rodent ulcer, epithelioma and pigmented flat senile warts. Zinc Sulphate Solution 2%, current 6 to 10 *m.a.*—L. i./09,763.

Old chronic thickened eczematous patches,—Zinc ions valuable. Contact for 5 to 10 minutes with 3 to 6 *m.a.*—B.M.J. i./09,1342.

Fistula in ano, granular lids, neuralgia and diphtheritic ulcer of the external ear well treated.—B.M.J. i./09,1301 ; ii./12,486.

Chronic urethral catarrh treated by probe wrapped in lint soaked in Zinc Sulphate Solution 2%—passing into the urethra connected with positive pole and constant current 2 *m.a.* for 10 minutes—repeated as necessary, good result. Where the aperture is narrow the canal may be filled with Zinc Sulphate.—B.M.J. ii./08,373.

An eminent gynæcological surgeon considers electricity in gynæcology "one of the biggest frauds inflicted on the confiding public." The work of Apostoli in the treatment of uterine fibroids is a direct negative to this. The paper here referred to describes the author's fifteen years' work in curative treatment—over 150 cases. Regarding

use of the galvanic (unidirectional) current, a battery of 30 to 40 Leclanché cells giving a voltage of over 50—is preferred to that from the main.

In using alternating current a secondary sledge coil having 8,000 to 9,000 turns of fine wire and capable of being tapped for a varying number of windings and having usual hammer type break is used—the larger number for sedative, the smaller for cumulative purposes. Average current for internal applications and for bladder cases is from 3 to 4 *m.a.* Special carbon electrode described is useful when applying *monopolar* current to any special part of the vagina. **Sinusoidal current** from a magneto electric apparatus driven by an electric motor, sometimes employed as a substitute for the faradic in dorso-abdominal applications using two clay pads with current of 3 to 8 *m.a.* as shown by faradimeter. An admirable tonic.—S. Sloan, P.R.S.M., *Electro. Ther.*, Sect. 1909, p. 15 *et seq.*

Zinc Ions in gynæcology.—For a case of simple cervicitis.—The zinc or copper electrode covered with cotton wool is inserted into the cavity of the cervix through the speculum which is filled with a 1% solution of Zinc (or Cupric) chloride. When the endometrium is involved the zinc electrode should be introduced into the uterine cavity and if insufficient action result or the case be a chronic one, the copper must be used, but this is more likely to be painful. In sepsis of the cervix either the zinc or copper electrode may be used with perfect safety by means of the speculum. Before passing an electrode into the cavity of the uterus the vagina and the cervix must have been rendered as far as possible aseptic—by ionic treatment if necessary.—S. Sloan, *L. ii./II*, 1764.

Ionisation in gonorrhœa. In cases where there is interstitial inflammation with keratinization the discharge contains a large proportion of keratinized cells and urethroscopic examination shows presence of hard patches—colourless and leucoplastic. Lavage is useless,—Ionisation gives best results. Maringe's method described. Apparatus used is a metal handle carrying above it a spur in which is fixed a movable rod, at the side a tube by which the liquid is brought. A non-conducting tube is fitted upon the handle and sheathes the metal rod. It is pierced in its whole extent by holes and its anterior end is olive-shaped for plugging the meatus. Fluids injected under pressure are retained and smooth out the folds of the mucous membrane. The penis is surrounded with a layer of absorbent wool, moistened with salt water, which will act as the indifferent pole by placing in it an aluminium electrode, fixing itself automatically. The ionizator is introduced, and the meatus plugged. The spur is joined up to the active pole. By the tube at the side of the handle the urethra is filled with a solution of chloride of zinc 1 in 300. The sensitiveness of the patient and the indications of the galvanometer act as guide. The current used is from 15 to 20 milliamperes, this is passed for from 5 to 10 minutes from mercury bisulphate batteries. The positive current is used first then reversed a few moments and stopped. The application is made every five days. After the second application the morning drop gets clearer, and its composition, which before treatment is made up of polynuclears, keratinized epithelial cells, cocci and rodlets, is found to be changed to the following:—At first there is intense desquamation of keratinized cells; after the fourth application the microbic flora disappear, and towards the end fibrin is seen to be present. In cases in which the discharge was at the outset microbic, ionization causes the reappearance of the flora by dislodging the cocci from their crypts, and destroys them in the end. Ionization is contra-indicated in cases accompanied by subacute inflammatory conditions of the mucous membrane, because it brings about a violent recrudescence the effects of which may prove serious.—Pr. Oct., '10, 420.

Colitis treated by making the + pole a rectal electrode to which is attached a 2 pint douche of Zinc Sulphate Solution 2% (warm), about $\frac{1}{2}$ pint of this is run in and the current gradually turned on to 15 or 20 *m.a.* (Zinc Sulphate is known to have a particularly healing effect on inflamed mucous membrane of this kind.) The current is allowed to pass to a negative electrode which is a combined dorsal and lumbar one for 15 to 20 minutes. The Zinc ions in this way pass thoroughly through the diseased membrane to the — pole. Gratifying results.—L. i./11,1068, B.M.J. ii./12,486. *c.f.* Silver.

Lupus vulgaris.—2% Zinc Chloride solution or a 10% solution of Zinc Sulphate is applied, using a Zinc electrode attached to the positive pole. The current is obtained from 12 or 24 ordinary galvanic battery cells, accumulators or direct from mains through a suitable board. 2 to 3 *m.a.* for each square centimetre of surface is a suitable intensity—for 10 to 20 minutes. Apply a Calamine or Lead Lotion to the crust which forms later; this will fall, showing considerable improvement. The treatment may be repeated every fortnight.

Zinc ions may owe their curative effect to several factors:—(1) They are powerful germicides, (2) they have strong coagulating drying properties; (3) as a result of the œdema produced by the current which may last for several days, serum laden with opsonins and phagocytes comes into contact with tubercle bacilli in the nodules.—L. ii./11,31. *See also* Pres. Nov. 1912,277.

Chronic ulcers and sinuses.—Zinc—in cases of chronic mastitis and chronic cystitis, using a Zinc rectal electrode, has given good results. In dermatology, wipe over the nodules with Caustic Potash Solution to dissolve off the gelatinous covering, then wash with saline solution or distilled water, and expose for twenty minutes to Zinc ionisation. If necessary may be repeated after 14 days. Gave result superior to any other method.

Bedsore ulceration, rectal ulceration, hæmorrhoids, anal fissure, ulceration in the mouth and nose, sinuses (chronic suppuration of the antrum), urethritis, vaginitis and leucorrhœa, skin affections (acne, furuncle, ringworm), well treated.—Lewis Jones, B.M.J. i./11,887; ii./12,486.

Corns and warts yield well to Zinc ions, using a Zinc plate and Zinc Sulphate Solution. Apply a compress of 1% solution some hours before ionic treatment.—H. Lewis Jones, B.M.J. ii./13,938.

Lupus vulgaris, intranasal lupus, rodent ulcer and coccogenic sycosis treated.—L. ii./12,1725.

Large inoperable malignant tumours have been treated by combined Zinc and Mercury ions. As strong currents are used, a general anæsthetic is first given. Amalgamated Zinc Mercury pencils are connected to the positive and thrust into the tumour. Current up to 900 *m.a.* or more. “X” rays in massive doses preferred.—L. i./09,758.

Onychia (ulceration of the matrix of a nail) treated by zinc ions. First the part is soaked with a pad containing a 5% solution of

zinc sulphate, then ionisation is conducted by a thread of lint soaked in 2% solution gently pressed within the nail fold.—Vos. Hugo Arch. Rontgen Ray.

Zinc Iodide.—Middle ear catarrh treated by ionisation of 30% Zinc Iodide solution with 3 to 4 *m.a.* of current. Goitre has yielded to ionisation with 5% Zinc Iodide as also acute tonsillitis and enlarged prostates and enlargement of the turbinates.—L. Kesteven, B.M.J. ii./17,423.

Zinc-Mercury Iontophoresis in cancer.—A Zinc pointed electrode is freely amalgamated with Mercury and immediately passed into the periphery of a cancerous growth with its point directed towards the centre; the current is then turned on, when about 150 *m.a.* has been reached. Other electrodes are inserted near the first with each rise of current, till a total strength of 600 or 800 *m.a.* has been reached. Has given good results.—B.M.J.E. ii./10,75. See also **Copper**.

Uterus, Inflammatory Diseases of.—Applications of the constant current and effects of Zinc-Mercury ions give brilliant results. Take the place of *currettement*, with the advantage that the diseased mucous membrane is destroyed and hæmorrhage arrested by the cauterising action. Antiseptic ions penetrate into the subjacent layers of tissue and the subjacent muscular layer is generally improved by the inter-polar electric action.—P.R.S.M. Obstet. Sectn. Nov. '09, p. 22.

Dental Application.—The maximum current employed is usually about 5 *m.a.* Increase or decrease current gradually so as to avoid shock. A sliding contact resistance coil is generally used for this purpose with galvanic batteries.

Pyorrhœa alveolaris is well treated by 2% Zinc Sulphate applied at positive pole for 10 to 15 minutes with a current of 2 to 4 *m.a.*

For chronic alveolar abscess 2% Zinc Chloride or Copper Sulphate Solution with 3 to 5 *m.a.* 5 to 10 minutes. The sinus can be easily treated by means of Copper or Zinc wire 0.3 to 0.5 mm. thick.

Periodontitis.—2% Zinc Chloride with 2 to 4 *m.a.*

In many forms of gingivitis and chronic alveolar abscesses effective.—*c.f.*, E. Sturridge, B.M.J. ii./12,487,491.

Iontophoresis in Eye work. The electrolytic solutions must be dissociated as much as possible— $\frac{1}{2}$ to 2% solutions suitable. The "electrode cushion" must be of uniform thickness, and so thick that the ions where it comes into contact with the metal plate cannot penetrate into the tissues during application. It is important to realise that the lachrymal fluid is an electrolyte on account of the Sodium Chloride contained. Further there is the influence of the Cocaine used as anæsthetic. Cocaine kathions are very active on the cornea. Special Electrodes and mode of treatment of the conjunctiva, edges of the lids and cornea are described.—Oph., Jan. 1911, p. 18. See also reference to this paper under Sodium Chloride and under Zinc.

Removal of elements.—Several black patches on the face due to Arsenic used many years previously. The patient's hand placed in water with + pole from a battery of six cells. Pad of wet lint over the patch connected with the negative and current passed fifteen minutes with desired result. Electrodes of Iron, Silver or Copper to be avoided in general. Platinum is always safe and Aluminium is useful.—L. ii./o8,13-14; P.J. ii./o8,346.

Lead Poisoning, Electrolytic Treatment. Patients, *e.g.*, lead workers, immerse their feet in a bath of water, a grid of Aluminium being fixed in this. The hands are placed in a similar bath, also containing an Aluminium grid, and the current from an eight cell accumulator is gradually turned on. The lead in the patients' tissues becomes ionised and driven from one pole to the other. Persons suffering from lead-poisoning show no signs of it after a week or two of this treatment, while a bath once or twice a week prevents lead settling in the system. Marked success in lead works.—T. Maltby Clague, C.D. ii./13,760. See also Sir Thos. Oliver, L. ii./13,527.

Kenneth Goadby, however, communicated results of experiments *in vivo* and *in vitro*, which give no support for the contention that lead is eliminated by electrolytical methods.—L. ii./14,846.

'Solubes, Ionic,' for Medication, are prepared of many of the above substances.

Strength.—Each represent 4.375 grains (0.28 Gm.) to produce, on dissolving in 1 ounce of water, a 1% Solution. Two 'Solubes' produce an ounce of 2% solution, and so on within limits of solubility.

The following are examples:—

P1 Cocaine Hydrochloride.	Mercury Succinimide.
Copper Sulphate.	Potassium Iodide.
Lithium Sulphate.	Quinine Acid Hydrochloride.
Magnesium Sulphate.	Sodium Chloride.
	Zinc Sulphate.

'Sterules,' Ionic, of the majority of the solutions are also prepared of strength suitable for use.

References.—Leduc's Electric Ions and their Use in Medicine (MacKenna's translation)—see also B.M.A. Address, B.M.J. ii./o7,631, Lewis Jones, Tibbles, and others.

For a theoretical study consult 'Conveyance of Electricity through Solids Liquids, and Gases and Production of Radiation.'—Sir Oliver J. Lodge, B.M.J. ii./11,885.

The physics of Ionic Medication. Experimental papers dealing with the treatment of gynaecological affections and with the depth of penetration of the (copper) ion.—S. Sloan, L. ii./11,1759; B.M.J. ii./12,491

RADIOLOGY.

'X' Rays, discovered by Roentgen in 1895, are produced in a vacuum tube on the passage of an electrical discharge of high tension from a Ruhmkorff coil*, at the point where the cathode rays (electrified particles emitted at a high velocity normally to the surface of the

* A Coil termed the *Sunarc Rectipulse Coil*, Patent 7311/15, produces high tension impulses entirely unidirectional and dispensing with valve tubes on coils. The apparatus provides current in which the secondary impulse due to the make in the primary current does not oppose that impulse due to the break, but appears in the same direction. This effect is produced by the arrangement of the primary current in such a way that the magnetisation of the iron core is reversed in sign at each successive impulse.

cathode) strike solid matter. In the old form of "X" ray tube this was the glass of the tube itself; in the new form (the invention of Jackson and others) the anti-cathode, which is also the anode and is usually of platinum, receives the rays from a concave cathode, which is of aluminium. They are focussed by its concave surface, and the "X" rays (ether vibrations or pulses) are propagated from the *front* of the platinum plate (which is set at an angle of 45° to the axis of the tube) in all directions into space at the velocity of light. For a more recent view of the relation between "X" rays and cathode rays, *c.f.* Radium—"γ" rays. (It would seem as if "X" rays are composed of at least 2 sorts of rays, one **capable of reflection** and the other not. The relative therapeutic value of the two types under investigation at the Cancer Hospital—the reflected rays can be concentrated—hence should prove of great service.—B.M.J. i./13, 82. *Nature*, Dec. 12/12, p. 410). By bringing the reflected rays to a focus the action may be intensified.—B.M.J. ii./13, 907.

"X" rays possess the power of exciting phosphorescence and fluorescence. In working from electric supply mains if current is not continuous, a high tension transformer is necessary, *e.g.*, that of Gaiffe or Koch.

Many substances are almost *transparent* to the rays, *e.g.*, paper, leather, wood, soda-glass, mica, sulphur, indiarubber, cotton, wool and silk. Others, like bone and glass containing heavy metals, *e.g.*, lead, are *semi-opaque*. The metals are *opaque* in approximate proportion to their atomic weights—lead and platinum being almost entirely opaque, whilst aluminium is comparatively transparent. Iodine and Iodoform are very opaque.

Barium Platinocyanide Screens are fluorescent to the rays and render the shadows of the opaque bodies visible. They are made by coating cardboard or other suitable material with a film of Barium Platinocyanide suspended in a solution of Celluloid in Amyl Acetate.

Screens are now made with substances other than Platinocyanide. The brilliance of a screen depends to a great extent on the molecular weight of the fluorescent compound.

The SUNC WHITE SALT SCREEN made with Cadmium Tungstate gives good contrast and definition and is unaffected by continued use. It is stated this body may supersede Platinocyanide. Other manufacturers employ Willemite. The advantage of the Cadmium compound is that when properly treated there is practically no after-fluorescence.

☛ "X" ray tubes are often called "hard," *i.e.*, those with high penetrative power in which the resistance is great—and "soft," *i.e.*, with only slight penetrative power, hence producing a dull radiograph as the rays from it are stopped to the same extent both by flesh and bone. These differences are principally due to the different exhaustion of the tube, a very high exhaustion producing the hard effect, and only one of partial extent gives the soft or dull results, but the size of the electrode also affects the results, *e.g.*, a small cathode gives a high resistance and high penetration, and a large one the opposite effects. Best contrasts are obtained with a tube of medium softness.

Tubes are now made so that they can be regulated to any degree of softness, and are also automatically self-regulating, so that when the resistance becomes too great, an alternative spark gap comes into play which liberates gaseous matter and thereby softens the tube.

In bi-anodal tubes an additional electrode of aluminium is fitted behind and to one side of the anti-cathode and is connected with it outside the tube by a piece of wire; this permits the passage of much heavier discharges, and the tube works "steadier." The glass of the tube is of soda glass, but special bulbs, in which lead-glass is employed, with the exception of a window which is of soda-glass, are used for the application of the rays in skin affections. These obviate the necessity of shielding the normal tissue from the action of the rays. Special shapes are also made for the application of the rays to various parts of the body, *e.g.*, by introduction into the uterus.

The value of a tube depends on its solid construction and the definition of the radiograph produced at a distance of a foot. Exposures necessary with good photographic plates (special rapid plates are made for "X" ray work) have to be ascertained for the particular tube employed. It is stated that for the foot and ankle the exposure should be three times that necessary for the hand and for the trunk ten times. The arms and legs below the knee require about four times that for the hand; the abdomen may require thirty times that necessary for the hand.

A good account of hard and soft tubes and the means available to regulate them together with notes on the subject in general, is given by C. T. Allen, P.J. i./17, 157.

"Duplited" Films are more rapid than ordinary plates. Radiographs can be obtained with them by single flash exposures even when two intensifying screens are used, thus making for clearly defined images, *e.g.*, of internal organs. The feature of these films is that the emulsion is coated on both sides of the film so that when an exposure is made, one has the effect of two sensitised surfaces separated by a thin layer of celluloid. They have the obvious advantage of lightness and small bulk as compared with plates.

Colour-Sensitive Plates.—A new type of the Schumann Plate to explore the extreme ultra-violet region of the spectrum by means of vacuum-spectrometers. Details *re* Ethyl-Violet 6B and Isocyanine and Ethyl Cyanine in connection with.—Jl. Rontg. Soc., Jan. 1920, p. 2.

Radio-Print Paper for direct "X" Ray photographs on paper has the advantage of eliminating risk of breakage.—Pres. Address. Review of Work G. B. Batten, J. R. S., Jany. 1919.

Bismuth Carbonate or Oxychloride suspended in Mucilage (1 drachm in the ounce) is used for examining œsophagus and stomach. See Vol. I. pp. 225, 230, 232. It is also used for pathological work, *e.g.*, to inject veins,—to outline them prior to radiographing.

Barium Sulphate is also employed, *q.v.*

Diaphanite.—A mixture of magnetic iron ore, milk sugar and cocoa. A black powder also used as a substitute for Bismuth.

It is important to work with the tube completely enclosed excepting for a small aperture, so as to prevent blurring effect from secondary radiation from the glass of the tube.—Sir J. Mackenzie Davidson, B.M.J. ii./07,632, *et seq.*

Catheters or **Bougies** impregnated with Bismuth employed in diagnosis of urinary diseases.—L. i./14,233.

Tubes made with Borate of Lithium and Beryllium, *i.e.*, low atomic weight elements, *viz.*, with weights 11, 7 and 9 respectively, absorb only $\frac{1}{5}$ of the amount of "X" rays of medium hardness absorbed by ordinary glass. Erythema may be produced by using tubes of this kind, *e.g.*, in skiagraphy of the chest. The exposure in such examinations using these tubes may be reduced to a third or fourth.

In **Coolidge's Tube** the anode consists of heavy tungsten, while the cathode is of light tungsten. There is no fluorescence. Streams of charged particles from the tungsten anode and cathode, which are heated in a vacuum, are driven by a powerful electric current, and the rays are formed; these are more or less penetrating in proportion to the speed with which the particles are driven, hence intensity can be controlled.—L. i./14,124; P.J. i./14,19; C.D. i./14,10.

Penetrating power of the X-rays from the Coolidge tube.—S. Russ, L. i./15,792.

New Aspects of Radiology.—A useful account of the various advances in Coolidge Tubes.—Maj. G. W. C. Kaye, Jl. Rontg. Soc., Apl. '20.

Secondary Radiation.

The hard Röntgen rays are little absorbed,—they can pass through the body without suffering any very enormous diminution, hence produce little physiological effect. The soft rays are absorbed more easily than the Beta rays of Radium. The whole of their energy is taken in by a very thin layer of the flesh which thereby becomes exposed to a most vigorous physical agency. It is important to get rid of these soft rays when using Röntgen Rays *in exploration*,—on the other hand, *for treatment* very soft rays are required. Their production is a matter of great difficulty; the best rays are absorbed on their way out of the tube, even if aluminium windows be used,—any kind of window would have to be thick enough to stand the external pressure. A discovery in this direction is of importance. It is well known that when Röntgen Rays strike against metal, or indeed anything, secondary rays are emitted, and their kind depends on the nature of the substance struck. The degree of hardness of the incident ray does not matter,—the quality of the ray given off is constant. One important point is to be remembered, *i.e.*, that in order to enable the metal to give out its particular ray the incident radiation must be harder than the radiation characteristic of the body, *i.e.*, a very soft radiation will not excite radiation from a metal of high atomic weight. Rays of almost any degree of hardness or softness may be obtained with absolute certainty by taking advantage of the fact that *the*

secondary radiation occurring when a Rontgen Output impinges on a metal, varies in hardness precisely with the atomic weight of the metal.—B.M.J. ii./10,559.

Metals of lower atomic weight than Calcium do not give out any secondary radiation,—they simply scatter the incident ray, but iron, copper, zinc, silver, etc., have their characteristic radiation. The radiation from iron would be absorbed by 1/100 m.m. of human flesh; those from copper would fall a little deeper. Those from silver have about the same penetration as the β -rays of Radium (to which, of course, all the therapeutic properties of Radium radiation can be attributed). Sir J. J. Thomson's suggestion is, therefore, to **expose silver to an "X" ray tube, and utilise the secondary radiation from this element.** Another point of interest is that the energy absorbed by Hydrogen differs from that absorbed by other substances—it depends on the quality of the ray. With the very soft rays given out by iron there is practically no absorption by hydrogen, but as the hardness of the ray is increased the proportion of energy absorbed by Hydrogen increases also. Diseased tissue may differ in chemical combination from healthy tissue, and in one case we may get a larger relative absorption than in another. A ray may be obtained which would be greedily absorbed by the tissues we wish to affect, and not absorbed to anything like the same extent by the normal substance. This may have important bearing therapeutically.—Sir J. J. Thomson, B.M.J.ii./10,512; see also Barkla p. 295, and **Argentum**, Vol. I, p. 146.

Secondary radiation from **Calcium Phosphate** in bone material possibly the means of cure of cancer by Radium. Suggestion to embed a piece of bone material in a cancer and expose to "X" rays from a tube with Uranium Anticathode. The results should be more favourable than those obtained from Radium.—L. ii./13, 1804.

Induced fluorescence as an aid to radio-therapy. **Calcium Tungstate** injected plus "X" ray exposures stated to retard growth of experimental tuberculosis.—P.J. ii./13,913.

Silicon Carbide— $\text{SiC.}=40\cdot305$ *Syn. Carborundum*—An exceedingly hard iridescent black crystalline substance made by fusion of Carbon, Sand and Sodium Chloride in an electric furnace. Employed technically in polishing. Used as Anticathode.—Na. Aug. 1911,215.

The dust of Silica, Graphite and Carborundum Works responsible for lung disease.—E. M. Collis, Int. Cong. Med., 1913; B.M.J. ii./13,406.

"X" Ray Shields—Iron and Copper should be avoided in making shields—they give out all the soft rays by secondary radiation. Metals with higher atomic weights give more penetrating secondary radiation and hence go through the flesh with less absorption and so produce less evil effect.—Sir J. J. Thomson, c./., above.

Red Lead and Plaster of Paris casts to enclose the "X" ray tube, also thick **Lead Glass Frames** over the fluorescent screen are necessary safeguards.—Sir J. Mackenzie Davidson, B.M.J. ii./10,512.

Leaded Rubber is also used for shielding purposes.

Glass Shields containing a high percentage of lead, are employed with a window opposite the anode through which the rays pass, and have the advantage that the tube can be watched.

The operator should at all times stand behind the plane of the anode.

Ionized air is believed to be injurious if breathed continuously; a large well-ventilated room should therefore be employed.

Patients and the "X" ray tube are preferably placed inside a cabinet lined with lead—the working being controlled from outside.—J. H. Sequeira, L. 11/13,1503.

Silk impregnated with metals arrests "X" rays, *e.g.*, silk treated with lead phosphotannate and other salts containing 68% of mineral matter, including 34% lead oxide, 24% Tin Oxide, 8% Phosphoric Anhydride and 2% of Lime and Alkalis. Slight discharges of "X" rays were practically arrested by this while 6 layers were sufficient to protect the skin against ordinary discharges of medium strength. As effective as Sheet of Copper 0.044 mm. thick.—M. L. Droit, Knowledge, Feb., '13, per P.J. i./13,164.

Protection in Diagnostic work. Methods employed against scattered rays and secondary rays.—F. Hernaman-Johnson, Jl. Rontg. Soc., Apl. 19, p. 45: see also R. Knox, Jl. Rontg. Soc., Jan. 1920, p. 17.

The **Teleradiography apparatus** enables a radiograph to be made at 2 metres with exposure of 1 second or less.—L. ii./o8,554

DEVELOPER FOR PLATES (Thomas's):—

No. 1.—Hydroquinone 160 grains, Sodium Sulphite 2 ounces, Citric Acid 60 grains, Potassium Bromide 40 grains, Distilled Water to 20 ounces.

No. 2.—Sodium Hydrate 160 grains, Water to 20 ounces.

This works satisfactorily. It does not stain the hands.

Equal quantities of these solutions are used for developing. Some employ the soda solution diluted so as to develop slowly, and thus produce better definition, but for routine work this takes too long.

The following **Metol Developer** also gives good results:—

No. 1.—Metol* 50 grains, Hydroquinone 150 grains, Citric Acid 20 grains, Sodium Sulphite 2 ounces, Water 20 ounces.

No. 2.—Caustic Soda 150 grains, Water 20 ounces.

Equal quantities of Nos. 1 and 2 are employed. Development is best conducted at 60° F.

"X" Ray Diagnosis.—As an aid to diagnosis, the "X" rays increase yearly in importance, particularly in examining fractures, in diagnosing phthisis, pneumothorax, strictures of the oesophagus, pleurisy, tubercle, aneurism, enlarged bronchial glands and for the detection of renal and ureteric calculi. Tubercular deposits can be demonstrated which have not been detected by ordinary means.

* Note.—Metol is the sulphate of Methyl-*p*-amidophenol $C_6H_4.OH(NH.CH_3)$, *i.e.* $[C_6H_4.OH(NH.CH_3)]_2H_2SO_4 = 344.31$.

The Trade Mark "Metol" (222,388) registered in 1899 has been **avoided**. Patent 15,434/1891 expired 1905.

* **Metenol** is a trade variety of it. T.M. 349,103.

* **Amidol**. This developer is the hydrochloride of Diamidophenol $C_6H_3OH(NH_2)_2.2HCl = 197.05$.

A German Company registered (No. 234,719) in 1901 a label containing the words "Amidol-Hauff." No. 373025 applies to the substance made in England. No. 363479 is Amidol-Johnson's.

Patents: No. 4498 of 1892 was in force for the whole 14 years. Patent 60,174 (27/1/91) granted to J. Hauff of Feuerbach deals with the use of *p*-Amidophenol and *p*-Amidoseresol as developers, but not with the manufacture of di-amidophenol. For manufacture see C.D. Sept. 19/14, p. 38.

(Para-amidophenol $C_6H_4NH_2OH$ is made from *p*-nitrophenol by reduction, *e.g.* with iron and acetic acid. M.Pt. 170°).

'X' rays in diagnosis of tuberculosis in children.—L. ii./12,1501.

The late Sir J. Mackenzie Davidson (B.M.J. i./98,10) devised an apparatus for exact measurement and localisation of foreign bodies. Two exposures are made on the same plate, the tube being moved right and left of a zero point on a scale, without the patient moving. On developing the plate the negative shows two shadows of the foreign body. From these, measurements are taken by means of threads with a surface gauge; this gives the exact depth of the foreign body below the skin. Some prefer to work with two photographic plates instead of one as mentioned. This method is also employed for the measurements of bones, displacements, and especially for pelvic measurements. The "**Cross Thread Localiser**" is also useful for detection, localisation and estimation of the size of foreign bodies in the eyeball and orbit. A piece of metal, less than a millimetre in diameter, can be detected in the eye. The removal of pieces of steel can be brought about by means of the electro-magnet.

The stereoscope applied to skiagraphs gives the object in relief and shows the true relation of the parts. The skiagraphs are taken from different points of view after displacing the tube about 6 centimetres. By practice it is possible to combine stereoscopic pictures without the employment of a stereoscope.—*For references to results in renal and other cases, vide Edn. XV., p. 658.*

Localisation of bullets and metallic foreign bodies. A simple device consisting of a dry cell, electric bell or voltmeter and two steel needles connected up with flexible wire.—N. E. Aldridge, B.M.J. i./15,70.

The Cross Thread Localiser of the late Sir James Mackenzie Davidson permits of the localisation of the minutest foreign bodies in the eye and gives most accurate results. Description of the method, including also the *Telephone* for affixing to surgeons' instruments.—B.M.J. i./15,1 *et seq.*; see also L. i./15,909; see also *Some Principles of "X" Ray Localization*, by W. Cotton, Pr. 1915.

Fragment of shell embedded in the internal popliteal nerve localised by Sir James Mackenzie Davidson.—L. i./17,719; see also L. ii./16,608.

Interpretation of X-ray Negatives.

The "X" ray negative should be examined, as it is more reliable than a print.

Cartilage casts no greater shadow than muscle. Calcified cartilage (as in the rib cartilages of old patients) also calcified arteries throw a distinct shadow. Dislocations are usually evident on a skiagraph, but some joints require stereoscopic views. Tumours cast little or no shadow.

Diagnosis of Renal Calculus by means of a Screen.

Once a stone has been seen on a plate there is a strong probability that it can be seen on the fluorescent screen, provided that the patient is not too fat, and that plenty of fluorescence can be seen on the screen.

A diaphragm is to be used to stop off all "X" rays except over an area half the size of the kidney. The stone can be seen more dis-

tinently when located by making the patient breathe deeply, and then the stone and the kidney will be seen to rise and fall at least $1\frac{1}{2}$ inches. *A calculus of Calcium Oxalate casts the darkest shadow.* Cystine stones come next in density, followed by Calcium Phosphate. Mixed phosphate stones cast still less shadow, and last in order come Uric Acid stones which may cast no shadow at all. Methods of procedure for diagnosis of **ureteric calculi** are also given.—A. H. Pirie, B.M.J. ii./10,584,586.

Renography.—

A fixed dense kidney with profuse hæmaturia indicates the presence of inoperable carcinoma of the kidney. A fixed dense kidney shadow, high up under the costal arch, with profuse, intermittent hæmaturia, means a "too late" cancer. A fixed shadow of a dense kidney, with stinking pyuria and a shadow of pelvic stones means nephrectomy. A wise procedure would be subcapsular nephrectomy by the lumbar incision, without touching or separating more of the pericapsular attachments than is just necessary to enucleate the organ and control its pedicle. A fixed dense kidney shadow without stone but with coli-pyuria or staphylococcic pyuria, generally needs the simplest pelvic drainage through the loin without disturbance of the pericapsular area. A dense fixed kidney shadow without pyuria needs serum for the treatment of the corticitis. The use of forced expirations and inspirations, with or without vertical posture of the patient, is most important, not only radiographically but clinically and operatively.—E. H. Fenwick. B.M.J. i./11,748.

The Normal and Pathological Stomach as seen by "X" Rays.

A radiograph is a record of the picture at one given moment only. Cinematographic radiographs would certainly be more ideal than screen work. The aspect of the stomach in cases of atony of the stomach; "dilatation," pyloric obstruction, spasmodic conditions and gastric ulcer, hour-glass stomach, carcinoma of the stomach, aërophagy and the duodenal ulcer are all dealt with.—B.M.J. ii./10,537.

Investigation of the motor functions of the alimentary tract by means of "X" rays.—B.M.J. i./12,225.

Anatomy of the normal stomach,—fallacies with Bismuth examinations.—A. F. Herz, B.M.J. ii./12,775.

With screens glazed with lead glass of tested opacity, the observer is thoroughly protected. Illustrations show a variety of obstructions, e.g., due to malignant growths and aneurism.—Jordan, P.R.S.M., Electro Therapy Sec., Dec. '10, p. 13. See also B.M.J. ii./11,699.

Thoracic aneurism. The only form which is not revealed with certainty by either anterior or oblique examination is a small aneurism confined to the concavity of the arch. Errors in diagnosis may frequently be cleared up by "X" rays,—phthisis is not infrequently diagnosed as aortic aneurism, while aortic aneurism is still more frequently mistaken for pulmonary phthisis.—B.M.J. ii./10,1575.

In the diagnosis and treatment of fracture,—L. i./00,1663.

Radiographing joints. Chronic arthritis in a deep-seated joint such as the hip may be demonstrated, and gouty and other chronic inflammations may be discovered.

Arthritis.—“X” rays the most accurate means of diagnosis at present.—Rheumatoid arthritis and osteo arthritis pathologically distinct.—R. Morton, B.M.J. ii./12,481.

Gas in Tissues (formed by *B. Aerogenes Capsulatus*, etc.) can readily be located by “X” rays. It appears as white patches in skiagrams. Radiographs assist in operations for securing free drainage.—B.M.J. i./17,8.

Delineation of internal organs and foreign bodies by a combination of “X” rays and electrical action. The apparatus employed is so arranged that a revolving piece of paraffin paper is perforated by needles that are electrically actuated according to, *e.g.*, the bullet in the brain, and from the paraffin-paper a print is made that shows the part of the body fainter than a radiograph, and an outline of the bullet.—J. Shearer, B.M.J. ii./16,459.

General Reviews of Treatment.

A recent summary of “X” ray therapeutics with description of technique, skin affections, enlarged lymphatic glands, exophthalmic goitre, disease of the blood, and ductless glands, diseases of the pelvic organs, malignant disease.—R. Knox, L. ii./19,183.

Treatment of lupus, rodent ulcer, and other skin affections with “X” rays and the Finsen Light and the two combined, are carried out with satisfactory results. The mode of action of “X” rays is not bactericidal. They appear to act by retarding osmosis and causing a slow degeneration of the cellular structure, probably due to leucocytosis. Lupus vulgaris, especially the ulcerative form (on ulcers the drying effect is most marked), scrofuloderma, tuberculous osteitis, and tuberculous glands, rodent ulcers, epithelioma, keloid, sarcoma, lupus erythematosus, acne rosacea, actinomyces, mycosis fungoides, Paget’s disease, naevi, eczema, psoriasis, acne, favus, sycosis, ringworm, and hypertrichosis have been satisfactorily treated by “X” rays. The rays cause the absorption of œdema.

Of value after operation to prevent recurrence in some forms of malignant disease.

Leukæmia. Investigation on treatment of. In some forms advantageous (myeloid, chronic lymphatic). There was improved constitution of the blood, diminished size of swollen organs, increase in weight and delay in recurrence. Complete cure never effected.—L. i./09,507; B.M.J. i./09,1299. Rays of fairly high penetration should be given. Screen 0.5 to 0.8 m.m. thick. Dose 6H to 8H once every two or three weeks or a smaller one more often.—B.M.J. i./11,985. The treatment may do so much damage to the liver as to cause cirrhosis. Cure of the leukæmia, but death after a year from cirrhosis and ascites.—B.M.J. i./09,1236.

Enlarged lymphatic glands amenable to treatment.—B.M.J. i./09,1299.

Graves’ Disease.—“X” rays may reduce excessive secretion due again to hypertrophy and over activity of the gland.—B.M.J. i./09,1300.

Gynæcology.—“X” ray treatment may be offered to a patient with contracted pelvis as a substitute for oophorectomy, *i.e.*, to produce atrophy of the ovaries. Many tumours of the ovaries, *e.g.*, early stages of proliferating cystoma might be beneficially treated by “X” rays.—B.M.J. ii./09,461

Venereal sores treated. Results valuable.—B.M.J. i./09,464.

Uterine fibroids treated by X rays.—J. D. Harris, B.M.J. ii./19,376.

Malignant Disease—

Sarcomata 35 cases and 304 deep-seated carcinomata treated with “X” rays with good result. In the sarcomata recoveries 50%: in cancer of the rectum good results from post-operative treatment.—L. i./09,1265; B.M.J. ii./09,143; i./10,434.

Inoperable uterine cancer treated. Pain may be relieved at the first radiation. Discharge less foul and hæmorrhage diminished.—B.M.J. ii./09,461. Uterine fibroids are stated to disappear under the treatment.—G. F. Haenisch, B.M.J. ii./12,474.

Malignant disease of the breast, inoperable—result of a blow from a falling ladder. Well treated with "X" rays.—W. F. Somerville, Glas. Med. Jl., Sept., 1913,184.

Treatment of Cancer by "X" Rays.

Barkla drew attention to the fact that cancerous affections in and near the skin do well, whilst deep-seated are not at all, or only slightly affected,—the diseased tissues have really received different treatment. This is due to the fact that the more efficient ionising radiations are absorbed by the superficial layers of flesh. The radiation penetrates right through the diseased part. Little energy is truly absorbed and little ionization takes place in the diseased tissues. Advises **Injection of Bismuth Carbonate at the part—to produce secondary radiation** Elements of high atomic weight scatter only a small fraction of the radiation transmitted through them, but it is transformed into much more absorbable and more intensely ionising secondary radiation of two types. Soft "X" radiation characteristic of the particular element emitting it and corpuscular radiation in character like B radiation from radioactive substances. If half a gramme of Bismuth Carbonate be distributed throughout 1 Cc. of flesh the ionisation produced by a transmitted radiation would through the agency of the Bismuth probably be of the order of 30, 40 or 50 times that produced by the direct action of the rays.—C. G. Barkla, B.M.J. ii./10,1532, *c.f.* also our p. 290 and the note under *Argentum*, Vol. I. p. 167.

TREATMENT OF MALIGNANT TUMOURS BY SECONDARY "X" RADIATION.—A beam of hard rays falling upon moderately heavy atoms does not suffer dissipation but conversion into softer rays. A solution of Strontium Bromide or Strontium Lactate is prepared isotonic with the body fluids, and is injected into the deep parts of a tumour mass. To prevent too rapid diffusion a little Adrenalin may be added, or instead of a solution of the above a $\frac{1}{2}$ to 1%, pseudo-solution of Collargol may be used,—this results in a deposit of **Metallic Silver** in the tumour,—unevenly spread. It does not actually enter the cell content but as the secondary radiation from silver penetrates 1.4 Cm. of tissue before falling to $\frac{1}{2}$ value this does not matter greatly. Make several punctures so as to spread the silver as evenly as possible, and use a very hard tube. As far as cancer of the alimentary tract is concerned chemically pure **Precipitated Silver** (*q.v.*) by oral administration is perfectly safe. These methods may be looked on as a reinforcement for "X" Ray work.—M.P.C. ii./11,681.

Alimentary Tract, Diseases of, treated by "X" rays with internal use of Metallic Silver. A patient treated on these lines was suffering from chronic ulceration of the large bowel. A preliminary Bismuth meal showed that food reached the cæcum in 5 hours and was delayed 24 to 30 hours in the ascending colon. Treatment consists in a **Silver Meal** (8 Gm. Precipitated Silver in a pint of milk with bread crumbs), 7 hours later "X" Rays under specified conditions. Repeated 8 times a week for 4 weeks,—ultimate complete recovery. A rectal case could be treated with an Emulsion of **Precipitated Silver in Olive Oil**. It is possible in this way to subject the mucosa of the stomach, duodenum or any given portion of the large bowel to a soft **Secondary Radiation** of considerable intensity. An interesting case is described where a rodent ulcer of the cheek was not making much progress until a new shilling was inserted—radiation was continued and there was complete healing.—B.M.J. ii./11,904.

Secondary "X" Ray Radiation in Medicine.—C. G. Barkla, B.M.J. ii./13 907.

Radiology.—In cancer, technique, etc.—B.M.J. ii./13,908—915.

Cancer treated by X rays in addition to saturating the patient with anilin dyes.—W. J. Morton, N.Y. Med. Jl., March 30, 1912

Malignant disease after operation treated prophylactically by 'X' Rays, also for treatment of recurrences and inoperable cases.—C. Saberton, B.M.J. ii./18,357. See also Reginald Morton, B.M.J. ii./11,901,

Rodent Ulcers.—Treatment should be continued until all raised edges however small, have entirely disappeared. 6H should be given once in three or four weeks, or 2H once weekly. Medium rays should be used and no screen.—B.M.J. i./10,433; i./11,985

Naevi—Medium Rays, without screen (or only 0.1 mm. of Aluminium). Give 3H or 4H once a fortnight. A large number of sittings are required. Radium gives more excellent results and is easier to apply.—B.M.J. i./11,985.

Ringworm.—If extensive, "X" rays best treatment, afterwards "finishing off" with Croton Oil.

Single dosage method harmless. Severe dermatitis followed by permanent baldness is the result of over exposure.—MacLeod, L. i./09,1373. The hair is several months in growing. In a large majority of cases it is necessary to irradiate the whole scalp. This by 10 or 12 exposures necessitates upwards of four hours. By dividing the scalp into rectangular areas, and irradiating each (surrounded by a lead foil sheet) in succession, the time is reduced to 2½ to 3 hours.—L. i./09,1378.

Great care should be taken not to exceed dose required to produce **temporary epilation**. Dose of 5H with rays of medium penetration (4 to 5 in. equivalent spark gap). No screen and one dose only should be required. There is danger of producing permanent partial baldness.—B.M.J. i./11,985.

Out of 270 cases all but 5 were due to *M. Andouini*. In 3 of the 5 *Megalosporon Endothrix*, and the remaining 2 to *Tricophyton ectothrix*. The skin in the case of *Megalosporon Endothrix* responded differently to "X" rays, becoming swollen and œdematous,—apparently a bad condition of kerion was produced,—in such there is risk of burning and producing permanent baldness. The two cases of *Tricophyton* cleared up after 4 or 5 weeks without any epilation.—M. Dobson, B.M.J. ii./09,455.

Lancet Commission on "X" rays. Favus practically eradicated from public elementary schools. A similar process may eradicate the closely allied tinea of the scalp.—L. i./10,52.

"X" rays have no bactericidal power, merely cause rapid epilation. The parasite and its spores come out with the hair root.—B.M.J. i./10,434.

200 cases of ringworm treated by "X" rays at Birmingham. The single dose method with a 12 inch coil in circuit with an automatic cut out switch, hence no danger of over dose. Average time for treatment of a single patch 5 to 8 minutes. Not a single case of "X" ray burn or of permanent alopecia—whichever parents would have reported. The method is safe and quick.—F. Emrys Jones, B.M.J. ii./13,849.

Ringworm, "X" rays in.—G. B. Batten, B.M.J. ii./13,924.

Far more rapid and certain than local parasiticides.—Douglas Freshwater Pr., Aug. 14,241

Tinea treated by "X" rays and Chrysophanic Acid Ointment. An ordinary "X" ray tube of medium hardness, or better, one of the "gas" tubes which can be regulated, or better a Coolidge tube. If a "gas" tube is used it should be tested to give a penetration of 8 by Wehnelt's radiometer. With a Coolidge tube the battery should be 4 amperes and the primary current 8 to 10 milli-amperes. Fair haired and very red haired people are more susceptible to "X" rays and require aluminium filters 1/16th to 3/16th inch thick.—C. J. Glasson, B.M.J. i./20,219.

Superfluous Hair may be well removed. A girl with a beard like a man received one dose—after a month, when the hair had fallen out, and all reaction had subsided another epilation dose was given on the now hairless skin of the face, and this was repeated each month for six treatments. The part was then left untreated. Seven months after the last treatment the hair had not begun to grow. Telangiectasis had not developed.—B.M.J. i./11,972. see also B.M.J. ii./10,522. Use filter of not less than 0.5 m.m. of Aluminium. Shield the lips in the case of a moustache and give good interval (1 to 3 months) for the skin to recover after the first fall of hair. Good results claimed.—A. E. Rayner, B.M.J. ii./12,480.

Hairy and Pigmented Moles. e.g., on face, usually improve—hair can be removed and pigmentation lessens. Use fairly large doses. Medium penetration. No screen—5H or 6H once in 3 to 5 weeks. Many doses may be required—must not produce a violent reaction.—B.M.J. i./11,985.

Alopecia Areata.—Small doses, e.g. 1 H or 2 H once in 2 or 3 weeks.—B.M.J. i./11,985.

Measles—Singular coincidence of the rash appearing on the areas rendered temporarily bald in course of treatment.—B.M.J. i. 07, 1298.

Exophthalmic Goitre—Some cases greatly benefited. Further trial recommended.—B.M.J. ii./05,1249. One case cured.—B.M.J.E. i./06,12.

Probably large doses essential to cause partial atrophy. Medium Rays should be used, 0.3 mm. Aluminium Screens and a dose of 6H to 8H once in 2 to 4 weeks.—B.M.J. i./11,985.

Eczema.—Can cure with certainty.—Give small dose each time—less than enough to turn the Sabouraud pastille—about 7 to 10 minutes according to the tube. Anode 6 inches from the skin (protected by 4 layers of blanket) $\frac{1}{2}$ to 1 m.a., is run through the secondary. 48 cases 14 cured, 22 much improved. Suitable for early cases and acute ones in which operation is feared. Take care to prevent dermatitis.—F. A. Stoney, B.M.J. ii./12,476; L. i./13,590.

Psoriasis.—When in large patches often favourably treated by "X" rays. A patch 4 inches in diameter disappeared after 2 doses of 6H (*c.f. infra*) with 4 weeks interval.—B.M.J. i./11,985.

Psoriasis and other skin affections, action of "X" rays in.—A thorough consideration of suitable dosages.—S. Ernest Dore, B.M.J. ii./13,1016. See also C. E. De Silva, B.M.J. i./18,9.

Urticaria Pigmentosa.—Three exposures at intervals of one week without any visible reaction for six months afterwards. Factitious urticaria and turgescence of the old lesions on irritation ceased and no lesions appeared. Recurrence after a few months—treatment again with "X" rays proved satisfactory.—B.M.J. i./07,1301

"X" ray treatment in nervous itching of the skin.—B.M.J.E. i./10,24.

Hyperidrosis.—Face, hands, armpits, feet, etc., 20 cases (9 being medical men) cured by "X" rays. Six sittings, one pastille dose each, at intervals of one month is the best treatment. In two cases a cure was obtained by two sittings. The rays produce an effect on the sweat glands, and either stop their action entirely or reduce it to less than normal.—B.M.J. ii./10,522; L. ii./11,433

Use Medium Rays without Screen, 5 H. Once in 4 or 5 weeks for several days suffices.—B.M.J. i./11,985.

Itching of Pruritus Vulvae in pregnant woman which prevented sleep, and began to affect the mind cured by rays.—L. ii./11,510; B.M.J. ii./11,826.

Adenoids and Enlarged Tonsils.—Radiological treatment takes longer but there is no shock to the child and no convalescent period. A hard tube was used—rays filtered and not more than a $\frac{1}{2}$ Sabouraud dose allowed to pass through any given area of skin. The rays applied laterally, the anti-cathode being above and behind the angle of the jaw so that the rays encountered the minimum resistance in reaching the tonsil.—W. Steuart, B.M.J. i./13,1157.

Physiological applications of radiography.—Na. June, 1911.

Advantages of "X" Rays in country practice.—B.M.J. ii./10,543.

Constitution and organisation of the "X" Ray Department of a General Hospital.—B.M.J. ii./10,53.

Radiography to indicate whether absorption of remedies has taken place, *e.g.*, a course of Iodipin, which apparently had not been absorbed during 12 months.—B.M.J. i./13,520.

Persistent suppuration.—Influence of 'X' rays on.—E. P. Cumberbatch, L. i./14,1392.

Fibrous bands and adhesions resulting from bullet wounds relieved by filtered "X" rays (through Aluminium 0.5 mm. thick). Results good.—A. Winkelried Williams, B.M.J. ii./16,754.

Malaria treated by X-irradiation of the spleen.—Jl. Rontg. Soc., Jan. 1920, p. 3.

Chronic intestinal stasis, Radiology in.—A. C. Jordan, L. i./20,756.

Massage and medical electricity in after treatment of convalescent soldiers.—Florence B. Lambert, L. ii./16,788.

Dosage. Sabouraud's Pastilles consist of Bristol paper coated with an emulsion of barium platinocyanide in amyl acetate colloidal solution. The alteration in colour caused in these pastilles at half distance, *i.e.*; $7\frac{1}{2}$ Cm, is observed and forms the basis of the dosage.

In this apparatus a pastille of 1 colour only is used (*c.f. Holzknecht's infra*). This represents the same dose as 5 on the Holzknecht scale. The machine has advantage of cheapness, etc., but indicates one dose only—viz. 5H.—B.M.J. i./11,986.

Holzknrecht's Chromo-Radiometer. In this a 'pastelle' changes color under the influence of the rays from a canary yellow to brown. The graduated scale shows various tints numbered from 3 to 24. The unit 'H' is that amount of raying needed to change the color of the pastelle from one tint to the next,—this indicates '1H.'—B.M.J. i./11, 1986.

There are further the radio chronometer of Benoist, the quantimeter (*vide* below) of Kienbock and the method of Milton Franklin by measuring the ionisation of the air produced by the radiation from the "X" rays.

The "**Wehnelt Radiometer**" consists of a silver strip, the same thickness throughout, and an aluminium strip, tapering in thickness, mounted side by side. These are moved across the slide in front of a fluorescent screen so that the lower half shows the shadow due to the Silver, and the upper half to the Aluminium. When the appearance of both halves are alike, the position of the strip is read off on a scale, and its position is accurately proportional to the penetration of the tube.

The **Kienbock Quantimeter** consists of strips of Silver Bromide paper and is exposed, developed, and then compared with standard scale. The spot where the tint agrees giving the value of the tube.

"X" Units given by this apparatus are $=\frac{1}{2}$ H, *i.e.*, $10X=5$ Holzknrecht's Units or the Sabouraud Tint "B."—B.M.J. ii./12, 474.

Measurement of Current through "X" ray tube—A milliamperemeter can be used to measure the current passing through the "X" ray tube, the production of rays bearing a close relationship to the current so measured. Photographs taken with different currents through "X" ray tubes are identical when the times of exposure are so adjusted that the figures obtained by multiplying currents by time are equal—*milliampere seconds*.

To measure the effective current through a tube the currents in the wrong direction are to be eliminated, *e.g.*, by aid of the **Villard Valve Tube**. This is arranged in series with the "X" ray tube. Its rectifying action is remarkably complete. The usual current through an "X" tube ranges between 0.2 and 1.0 milliampere. A current between 0.5 and 1.0 is sufficient for good average work.—Lewis Jones.

Dose.—The means of controlling the penetration are in the main the regulation of the vacuum for 'hard,' 'medium,' or 'soft' rays. For regulating the vacuum self-regulating tubes are used. *Screens* are used to absorb the softer rays—that is, those whose chief effects are on the skin, when the object is to affect deep structures. they may be made of wash-leather and gelatin; *Sheets of Aluminium* 1 mm. in thickness superimposed on one another, the number used depending on the effect desired are also employed.

A *small dose* temporarily stimulates epithelial structures, increases secretion from the sweat and sebaceous glands and increases vigor of hair growth. A *full dose* may be followed by a slight erythema after a latent period of some ten days. Hair becomes pale and drops out,—but growth starts again some 6 to 12 weeks afterwards. A *large dose* is followed in about a week by erythema, increasing in severity. Marked inflammatory reaction sets in, and vesication takes place, necrosis follows, deep or superficial according to quality of rays absorbed. The ulceration may last for years. It may ultimately become epitheliomatous. *Repeated doses* produce results according to whether the further dose is or is not administered before the effects of the previous one have passed off. It can be exercised as to dosage and interval between, a great number may be given.

Holzknrecht's, Sabouraud's and a third method of estimating dose, used by the Author of this paper, are described. In the last a milliamperemeter is used on the tube circuit and a meter to count the number of "X" Ray **Impulses** administered at one sitting. An impulse is originated each time the current in the primary circuit is interrupted. One has, therefore, only to count the number of revolutions the interrupter makes during the sitting. This is effected by a revolution indicator similar to a bicycle distance recorder attached to the spindle of the revolving interrupter. The following points have to be attended to:—

The distance between the anticathode (the point from which the "X" rays emanate) and the part treated—the *best distances* are 6 inches and 9 inches—the diameter of the area treated should always be less than half the distance for even distribution. (2). The penetration of the rays and (3) the amount of current passed through the tube. "The arrangement is standardised to

Holzknicht Unit equivalents—*e.g.*, if a tube having a penetration represented by $4\frac{1}{2}$ inches spark gap has $\frac{1}{2}$ a *m.a.* passing through it, and Sabouraud's pastille (placed at 3 in distance) is reduced in 5,000 impulses, with an applicator to fix the part at 6 inches distance $1H=1,000$ while with an applicator fixing the part at 12 in. distance $1H=4,000$. In order to calculate the number for any other distance one works on the law that light diminishes inversely to the square of the distance." By this method one is able to vary dose within wide limits and the personal equation is eliminated.—B.M.J. i./11,895.

The clinical significance of X-ray and Radium measurements.—L.i./12,289.

In "X" ray treatment it should be remembered that the effects of repeated doses are cumulative for at least three weeks so that not more than the total of a full dose (calculated by Sabouraud's Pastille) should be administered within that time. The following rules have been found satisfactory (1) any dose between $\frac{3}{4}$ and 1 should not be repeated within three weeks. (2) A half dose may be repeated after 14 days and then after another three weeks. (3) A $\frac{1}{2}$ dose may be repeated after 7 days and then after 14 days and again after 3 weeks. (4) $\frac{1}{2}$ of a dose may be repeated weekly. The first is best for ringworm, favus, hyperhidrosis keloid, angiomas, warts, naevi, benign tumours such as fibromata, myomata, lipomata and epitheliomata of the skin, especially rodent ulcer. The second is best for hypertrophic lupus of the skin or mucous membranes, ulcerative tuberculosis of the skin, scrofulous glands, all forms of scrofuloderma and in erythema nodosum. The third is best in many of the more chronic and persistent dermal diseases such as eczema, psoriasis, pruritus ani and vulvæ, prurigo, acne vulgaris and rosacea and sycosis. The fourth is convenient for the milder forms of skin disease occurring in susceptible regions.—W. Knowsley Sibley, Pr., March, '13, 615.

"X" Ray Installation and work for Pharmacists.—Description of apparatus etc.—P.J. i./13,4,166.

Lectures by R. S. Wright dealing with the apparatus used in the medical applications of electricity. 1st, Medical application of low-tension currents for galvanic currents, faradisation, cautery, radiant heat, vibro-massage and ultraviolet radiation.—P.J. i./14,132. 2nd and 3rd, High tension currents in "X" ray work.—*Ibid.*, p. 212,291. 4th, Direct application of high-tension currents.—*Ibid.*, p. 402.

"X" rays were used for revealing defects in aeroplane timber—wood is very transparent to the rays.—G. W. C. Kay & R. Knox, C.D. '19, 537.

Dangerous and Untoward Effects to Operators and Patients.

Doubtful if any action on the ovaries of a woman.—L. ii./06,689; L. i./07 197,1753; see also other references to this subject, Edn. XV., p. 666.

Testicles of rats exposed to 'X' rays soon contained no spermatozoa—the soft rays are the most easily absorbed by tissues—they have to be filtered out when it is required to reach deep tissues with the hard rays.—Clunet, B.M.J. i./14,107.

"X" ray Dermatitis.—Dangerous results to hands may follow long exposure, relieved by application of Salicylic Acid, Menthol, Cocaine and Lanolin, Iodol.

"X" ray Burns, Treatment of. An operation introduced for the relief of bad cases in which painful ulceration has occurred and proved rebellious. Slight cases can be managed with fomentations, lotions, pastes and Unna's Zinc Gelatin.—A. Eddowes, B.M.J. ii./10,862.

Superficial "X" ray dermatitis can be cured by Radium. Sir James Mackenzie Davidson said that in most cases of "X" ray burns of the hands, the burns ended sharply at a line corresponding to the coat cuff. Now the cloth of the sleeve is quite transparent to "X" rays. This would point to the "X" ray burns being due to a Secondary "X" ray.—B.M.J. ii./10, 512; i./12,326.

Treatment in Graves' disease showed that if pressed too fast dermatitis likely to be produced. A filter of 4 to 6 layers of note paper used with success. Morton has employed pads of lint soaked in Sodium Tungstate Solution. B.M.J. i./09,1300. The lint is soaked and dried.—B.M.J. i./10,433

Squamous cell carcinoma of hand caused by "X" rays.—Lazarus Barlow B.M.J. i./09,1465;

Influence of "X" Rays on the thymus gland. Experiments on rabbits showed degeneration of lymphocytes within three hours of exposure, and within 12 to 48 hours disappearance from the gland.—B.M.J. i./11,1318

Effects of "X" rays on thyroids in rabbits.—B.M.J. i./12,28

See also *Secondary Radiation*, p. 289-291.

Treatment of Injuries caused by Electric Currents.

In case of shock—death is only an apparent death at first. It is often possible to resuscitate by artificial respiration if resorted to *at once*.

If patient is in contact with the wire pull him away by catching hold of his *clothing* or by using a good thick layer of cloth, *e.g.*, one's coat (*dry*), or by using a newspaper. Do not touch him unprotected—use rubber gloves if available.—R. Morton, L. ii./12,1539.

In any circumstances the breaking of the current means a fresh shock to the individual concerned. If in contact with a live wire this is to be cut, if possible, with long iron scissors in wooden handles.

For **Treatment of Burns** Boric Acid Compresses or Charcoal Poultices if there is much destruction of tissues.—Sir Thomas Oliver Lodge, L.i./11,363. A common result of a severe electric shock is rupture of fine vessels in the brain. Hence, in *first aid the head should be raised, not lowered*.—B.M.J. ii./10,515.

A dry skin offers greater resistance to the entrance of electrical current than a moist one.

100 volts is thought to be dangerous—50 may be considered unsafe. The danger depends also on amperage—1/10 ampere would produce death, but medically persons have 'endured' one ampere without fatal results. The difference in sensibility to electrical current on the part of animals is very great. 100 volts will kill a horse or dog, whilst author had been unable to kill a frog by electrical current. Volt for volt direct current thought more dangerous than alternating.—B.M.J. ii./10,515 (*c.f. infra*).

A current of only 65 volts killed a man through touching an electric lamp; on the other hand there are instances of even 20,000 volts not killing.

Electricity, like poisons, affects in different degree various animals and persons—tortoises in addition to frogs (*c.f.*, above) are almost immune, while mice and horses are most susceptible.—Prof. Jellinek, B.M.J. ii./12,1471.

45 deaths by shocks of less than 250 volts during the last 10 years, only three deaths from *continuous* current during period.—Scott Ram, B.M.J. ii./12,1471.

Deaths by Electric Currents, Detailed Description of.

There is not the smallest danger of sudden death if the current enters one foot or leg and leaves by the other, but there is danger if only 65 volts travels *through the thorax and so has chance to pass through the substance of the heart*. Account of experiments of electrocution of animals. The frog survives currents of all voltages—1,000 volts and more—and shocks from induction coils and charged Leyden jars. The dog, on the other hand, can be killed with certainty by an alternating current of perhaps 15 volts or 60 m. a. applied so as to pass largely through the heart muscles for 2 seconds only.

The question of danger to man of electric currents is discussed under six headings (a) *Voltage*.—Death has occurred from shock at voltages as low as 65 with *alternating* currents. In one case a *direct* current at 95 volts caused death. (b) *Amperage*.—70 to 90 m. a. of an ordinary alternating current would be enough if the current went through the chest and heart. (c).—*Duration of the contact*. (d).—*Industrial alternating currents* are, other things being equal, more dangerous than continuous currents (2 or 3 times as powerful.—Board of Trade agrees as to this). (Alternating current that reverses the direction of its flow 100 times a second is described as an alternating current

of 50 *periods* or cycles a second, or as having a frequency or periodicity of 50 cycles). The frequency is of great importance in considering its dangerousness to life. (e).—*Position of electrodes*. The heart is the danger point. (f).—*Resistance at the Electrodes*.

Treatment of Persons Struck by Lightning.

Fresh air, loosen clothes, artificial respiration. If it were immediately within a few minutes—available to give strong electric shocks to the præcordia, it would be well worth trying in desperate cases. As to stimulants, none seem to have met with any success.

A most extensive literature on these matters.—A. J. Jex Blake, B.M.J. i./13,423,492,548,601.

Static Electricity, Uses of.

In relief of pain in neuritis, lumbago, and other myalgias, and in synovitis. It is effective from its first application. Details of method of treatment are provided.—B.M.J. ii./09,459.

Lupus treated in a few months by this, which by Finsen method certainly would require two years.—P.R.S.M. Electro-Therap. Sec., Feb. 10,73,84.

For ordinary purposes a machine with 8 or 10 revolving plates is used. The Static Induced Current is praised in America for sciatica. In Morton's method of Static Induction Leyden Jars are connected to the two poles and their outer coatings are attached to connecting cords—ordinary pad electrodes which are applied to skin and muscles. The Static "breeze" or indirect spark application is also used for muscular pains.—B.M.J. ii./11,579.

Lumbago well treated by combined radiant heat and static wave current.—A. P. Luff, B.M.J. ii./13,858,859

High Frequency Current.

This consists of a condenser discharge through a coil of high self-induction, the resulting discharge being of very high rate of oscillation and of high voltage.

D'Arsonval first described the method of applying electric currents of high frequency.—The various methods of treatment, *e.g.*, by auto-condensation, high tension, effleuvation fully described—the paper should be consulted.—L. ii./09,12.

The essential parts of a high-frequency apparatus—Condenser, Spark Gap Solenoid and Resonator and notes on the working.—B.M.J. ii./09,923.

The principle of the apparatus required is comparatively simple, *i.e.*, to charge Leyden Jars whose outer coatings are connected by a helix of wire or solenoid. The inner coatings of the jars terminate in knobs whose distance apart can be adjusted to suit the sparking distance of the charging electromotive force. The jars when charged to a sufficiently high potential (from a Wimshurst machine or from an induction coil of large size or through a high potential transformer from the alternate current supply mains) discharge in an oscillatory manner across the air gap and through the solenoid connecting the outer coatings and the latter becomes the seat of electro-magnetic induction effects, comparable to those of the primary circuit of an induction coil, so that a derived circuit formed by wires leading from the two ends of the helix yield a current, as do the wires of the primary current of a coil—the apparatus is in short a modified induction coil.—Lewis Jones.

There are four methods of administration of high-frequency currents:—

(1). Auto-condensations, in which the patient is connected directly to one pole of the high-frequency transformer and lies on a couch, the other pole being a plate under the cushion which acts as an insulator across which the current jumps at each impulse.

(2). Auto-conduction, in which the patient sits inside a cage composed of a solenoid of thick copper wire from which the current is discharged through the patient on all sides

(3). Effleuve, which is the application of high-frequency currents locally in the form of a brush discharge, *i.e.*, a shower of minute sparks.

(4). Direct application which, as its name applies, is the direct application of electrodes to the body. These electrodes are usually made of glass and shaped to fit various parts of the body, including the cavities.

The high frequency apparatus illustrates well the inertia of electrons. The H.F. current prefers to "jump" an air gap rather than traverse a spiral rod of copper, and will cause a high-resistance incandescent lamp to light up which is short circuited by a top bar of copper.—Ma., Jan., 06, 285.

Uses.—These waves modify the sensibility amounting almost to an anæsthesia. Their use is stated to be practically painless. Pruritus, psoriasis, eczema, alopecia, zona, acne, impetigo, neuralgia, ataxy neurasthenia, warty growths, trachoma, lupus vulgaris, and lupus erythematosus have been treated with good results

High blood pressure satisfactorily reduced.—B.M.J. ii./09, 67, 79.

In angina, more especially "angina minor," good results.—Clifford Allbutt. —B.M.J. i./09, 1127.

Nævi.—The only class benefited is that comprising port-wine stain, *i.e.*, H.F. current is only applicable where the growth only involves the superficial layers of the skin. The minimum distance of the electrode from the skin should be $\frac{3}{4}$ inch.—this is the least likely to be followed by keloid changes in the scar,—general anæsthetic necessary. Refrigeration, *q.v.* preferred.—L. i./809, 165.

There is an inclination among many neurologists to look somewhat askance at H.F. work. Many neurasthenics—including in that term able-bodied persons merely nervously overtired—frequently find H.F. applications of benefit,—it may, if nothing else, be regarded as a useful tonic.—B.M.J. ii./10, 559,—see communication *ibid*, p. 527.

Effects of Electrical Currents on blood pressure.—Cases of hypertonus in which the motor spasm was relieved by high frequency—in neurotic subjects, chronic Bright's disease, lumbago, sciatica, gouty eczema, acute urticarial kraurosis vulvæ, climacteric flooding.—B.M.J. ii./10, 105.

High frequency in various diseases.—Luke, Pr June 1914, 845.

Diathermic treatment.—For passing heat into the body and for coagulating purposes. In diathermy a tension of 200 to 800 volts and an amperage up to $2\frac{1}{2}$ amps. are used.

In D'Arsonvalisation high tension, 100,000 to 150,000 volts, is necessary for production of effleuves, fulguration, etc., but at the moment when the human body is introduced in the circuit the resistance is so much increased that the tension falls to 2,000 volts or less and a great part of the energy is transformed into heat.

Nagelschmidt's Apparatus consists of oscillating circuit, condenser, spark gap and self-induction coil giving about 1,500 sparks per second. Diathermic effects can be localised in the tissues treated and extends evenly to a considerable depth. There is no pricking sensation, no stimulation of nerve or muscle or electrolysis and ionic action. An important point in this treatment is that the conductivity for various tissues is almost the same—hence currents can be exactly localised.

Clinically the method is applicable in two ways, (1) by elevating the temperature of the tissue to coagulate and hence destroy, *e.g.*, malignant tumours, (2) to raise temperature only slightly—to stimulate vitality. In the first case diathermy is rarely practised to a greater depth than 1 or 2 Cm., and this is supplemented by scraping. Among the several advantages claimed for the treatment we notice the following:—In operating on a cancer, lupus, etc., it is never certain how often the knife cuts through layers of proliferations of cancerous cells or lymph vessels filled with tubercle. There is always danger of transporting bacilli or cancerous cells into the newly-opened lymph channels. Diathermy coagulates and seals the lymph-channels and blood vessels, and permits extensive operations without bleeding. Current of $2\frac{1}{2}$ amps. usually sufficient.

For further details consult the original article.—Nagelschmidt. Thermal Effects of H.F. Currents. P.R.S.M. Electro. Ther. Sect., Nov., 1910, p. 1, *et seq.* See also B.M.J. ii./11,900; and a useful summary by H. Lewis Jones, L.i./14,375; villous tumours of the bladder successfully treated, L.i./14,1501; Diathermy and Radium Compared.—W. Hill, L. ii./14,385.

Alternating Magnetic Fields apparently stimulate the nerves of sight and possibly of hearing.—Prof. Silvanus P. Thomson's Experiments at the City and Guilds Tech. College. The colours and lights were originally seen at night over some of the magnetic machinery by the workmen at the Nitrate Works at Notodden, in Norway.—J.R.S., July, 1912.

Neuro-Electricity.—Three fundamental principles:—

(1) Chemical generation of nerve force (neuro-electricity) takes place in the human body. (2) The body has great conductive and inductive capacity. (3) All liquids and moist substances have inductive and conductive capacity.

The E.M.F. (electric motive force) is practically constant for the same individual. The Sign, E.M.F., and current vary in different patients.

Disease does one of at least four things:—(1) Alters the resistance of one or more conductors in the parts affected. (2) Affects E.M.F., locally or generally. (3) Alters skin resistance locally or generally. (4) Affects insulation resistance locally.

Temperature indicates a breakdown of local resistance, and the first step to stop inflammation is to stop the leakage by means of a *dielectric*. The dielectric must be a harmless, insoluble and undecomposable fluid of very great penetrative power and high electric resistance which, when applied on a pad of absorbent wool, can be relied upon to reach the site of inflammation in an hour or so and stop the leak owing to its action as a dielectric. **Liquid Paraffin** is mentioned as being a suitable dielectric (insulator).—J. Horne Wilson, Pr. June, 1914, 831.

Baines' Dielectric for internal and external use.

Dose.—1 drachm to 2 ounces.

Recommended for consumption, pneumonia, bronchitis, croup, piles, pericarditis, appendicitis, neuritis, burns and scalds, rheumatoid arthritis, inflammatory skin diseases, etc., etc.

According to Professor Bayliss this is ordinary liquid paraffin. It does not pass through the skin and cannot reach any nerve or other internal tissue. Treatment of open wounds by Liquid Paraffin has some justification in excluding air and perhaps bacterial infection. The results have no relation to insulating properties and there is no superiority over commercial samples.

"Nerve leaks" are merely places where the skin is moist and they give no indication of lesions in the nerve centres.

Wounds in a denervated limb heal quite as quickly as those in a normal limb. (Clara Jacobson's experiments).—Prof. Bayliss, B.M.J. i./17,387.

Radiant Heat.

This treatment consists in employing the heat and light produced by a number of ordinary incandescent electric lamps within a reflecting case.

Dry hot air produces a local hyperæmia and so relieves painful joints, chronic rheumatism and arthritis. Steam used in addition sometimes.

Iodine ionisation by cataphoresis of 2% Lithium Iodide as an addition—the joints being connected with the negative pole.—B.M.J. ii./10,518. *C.f.* also Iontophoresis.

Fibrositis.—In localised forms of. Dry radiant heat followed by ionisation with 2% Lithium Iodide Solution. In chronic villous synovitis of the knees most effective.—A. P. Luff, B.M.J. ii./13,858.

Finsen Lamp.

The concentrated light produced by this lamp is violet and ultra-violet. It is produced by an arc lamp in which the heat rays are cut off. Finsen's original lamp has been improved, and is now known as the "Finsen-Reyn" lamp.

Injections of fluorescent substances, *e.g.*, **Æsculin** 5 minims of a 5% solution immediately beneath the skin to be treated (*v.*, Vol. I., p. 774), and are sometimes used as adjuvants.

Ultra-Violet Rays. (**Uviol Light.**)

The first form of ultra-violet Light was the Finsen Lamp used in lupus. The Carbon Bisulphide Lamp and the Mercury Vapour Lamp produce also ultra-violet Light, the latter in particular has

been developed by P. Cooper Hewitt. Schattner and Kusch enclosed the mercury in tubes of fused rock crystal—thereby obtaining a very strong source of the Light. For lighting, these quartz tubes must be enclosed in glass which completely absorbs the 'uviolet' Rays.

An outfit for producing the rays consists of quartz tube containing Mercury. A resistance coil enables voltage to be adapted to the requirements of the lamp. The eyes and skin must be protected in using by an ordinary sheet of glass.—L. i./13,1503.

Have been used in lupus with good results. A sun lens is used, and a "compressor" in which plain or coloured water circulates.—I.M.G., Oct. 1904, 366
Alopecia treated by ultra-violet light successfully. Several cases cured.—Pres., 1910, 40; L. ii./12, 25. Syphilis has also been treated.

Tungsten Arc Light.—The amount of ultra-violet radiation obtained from any metallic electrode appears to be directly proportionate to the melting point of the metal. Tungsten has the highest melting point of any metal obtainable. Tungsten arc electrodes appear therefore to be the most efficient source. Radiations have destructive action on micro-organisms and cause active hyperæmia in superficial tissues. Protection of the eyes essential. Indolent and sloughing wounds much benefitted, also pustular eczemas, lupus erythematosus temporarily improved.—W. J. Turrell, L. ii./16, 790.

(**Tungsten Syn.** (German) **Wolfram**, W = 184. With Uranium and Molybdenum forms the Molybdenum group of metals.

The metal is employed in Coolidge's tube, *q.v.* It is in many respects more durable than platinum and considerably cheaper.)

The so-called "Simpson" Light is a light of this description in which the electrodes contain Tungsten. It is composed of the rays of the luminous spectrum, together with a large proportion of the ultra-violet. The therapeutic action is due to its richness in ultra-violet rays. The exposures given are short—2 to 5 minutes.

Rodent ulcers, lupus, syphilis, eczema and tuberculous glands treated with success at St. Bartholomew's Hospital. The light seems to stimulate healing of wounds. Inhalations of the vapour and fumes emitted have been used in asthma.—W. Douglas Harmer and E. P. Cumberbatch, L. i./16, 76.

Venereal cases—primary, secondary and tertiary, soft chancre, bubo in the inguinal glands, balanitis and a case of impetigo contagiosa treated with the rays.—E. G. French, L. i./16, 240.

Septic wounds treated. Pain and swelling relieved, movement increased, scar tissue absorbed; discharge from wounds immediately diminished. Dose $2\frac{1}{2}$ to 3 units at each sitting. Usually 2 sittings a week. Cases of lupus, tuberculous ulceration and Graves' disease have improved.—J. A. Menzies, L. i./16, 508.

The penetrative power of the light in this lamp is negligible and the radiations have nothing in common with the "X" rays—the rays failed to penetrate human skin or frog's skin—they are actinic rays and there is no essential difference between them and actinic rays from other sources of light. Any deep effects caused by them are due to counter-irritation—like that produced by light baths or a mustard plaster.—J. H. Sequeira, L. i./16, 405.

The lamp should be called the Tungsten Arc or at any rate the Simpson Tungsten Arc. Anyone who has experience of the rapid and remarkable effect of "X" rays on Graves Disease will not substitute these non-penetrating rays.—F. Herniman-Johnson, L. i./16, 586.

WATER STERILISATION.

Bacteria in water can be killed with remarkable speed by ultra-violet Rays. The Cooper Hewitt Apparatus provides 132 gallons of sterile water per hour.—L. ii./10, 1784 gives particulars of experiments conducted with an improved type of the apparatus. With a flow of more than 600 cubic meters per 24

hours through the machine, and a consumption of less than 26 Watts per cubic metre, a content of 500 to 1,000 B. Coli per litre and total germs of 20 to 260 germs per cc. in the in-flow: the B. Coli were reduced to nil and the "germs" to practically nil in the out-flow. There would appear to be a wide and great future for this new system. It destroys both pathogenic and non-pathogenic organisms and all spores.

14 specimens of water treated by the ultra-violet rays were absolutely sterile.—L. ii./11,779; see also B.M.J. i./13,464.

The rays from the quartz-mercury lamp colour manganese glass violet within 12 hours. It is suggested that the mixture of Ferric and Manganous Silicate become changed into Ferrous and Manganic Silicate.—C.D. i./05,756: L. i./05,512.

On a method of producing ultra-violet rays by low tension high frequency currents.—L. i./06,587.

Mercury Vapour Lamps, violet and ultra-violet rays from, have considerable germicidal effect on an organism like *B. prodigiosus*.—Hewlett, L. i./09,743.

Milk can be sterilised by this means.—L. i./09,798.

The proportion of ultra-violet Rays emitted by a given Lamp depend greatly on whether it is water-cooled or not and also upon the age of the lamps.—Na., July 1911, p. 102.

The action of the ultra-violet Rays of the Mercury Lamp on *Citrate of Silver Paper* is parallel with the bactericidal action upon *Bacillus Coli* and the yield of such a lamp when used for sterilising purposes may be very conveniently controlled by such papers.—Na., Aug., 1911, p. 169.

A solution of Ammonium Nitrate under the action of ultra-violet light forms some Nitrite. The effects of ultra-violet light are generally similar to those of ferments.—Na., Mar., 1911, 68.

The ultra-violet radiation of the Mercury Lamp is more intense as the temperature of the luminous tube increases. For experiments in photo-chemistry the lamp may be relied upon as a constant source of ultra-violet rays, the radiation being defined when the voltage, amperage and length of tubes are known.—Na., Aug., 1911, 272.

The action of ultra-violet rays on certain toxic substances. Cobra venom is rapidly destroyed by exposure to these rays. Strophanthins have their activity markedly diminished by exposure to the rays for 30 to 120 minutes. Saporin completely loses its hæmolyzing power after such exposure.—P.J. ii./11,779.

Ultra-violet radiation between wave-lengths 2960 and 2100 Å.U. (**Angstrom Unit**, the standard by which wave-lengths are measured) is germicidal to bacteria. Rays over this range of wave-length are also particularly absorbed by the substances of which bacteria are composed. Human skin in a layer as thin as 1/10 mm. is practically opaque to radiation over a very similar range.—C. H. Browning and S. Russ, Proc. Roy. Soc. B., Vol. 90, 1917. See also an exhaustive paper by C. A. Schunck.—L. i./17,996.

Reflected Sunlight.

Laryngeal tuberculosis has been treated by the sun's rays reflected from a laryngoscopic mirror, but the evidence of its value is doubted.

B. typhosus is rapidly killed by sunlight. In an experiment in India 240,000 organisms were reduced to nil in 2 hours.—R. T. Hewlett, L. i./09,742.

The value of sunlight.—B.M.J. i./14,210.

Moonlight may be responsible for decay. Being reflected light it is more or less polarised, and possibly polarised light may exert peculiar chemical action. Experiments on slices of cut fish with polarised light and direct light respectively showed that the former always decomposed first.—Chemical News, per L. ii./13,1203.

RADIUM.

Ra=226.

Radium was prepared by Madame Curie and M. A. Debierne (1910) in the pure basic condition by electrolysing a solution of a Radium Salt, using a Mercury cathode:—

Preliminary experiments with Barium, using about 0.1 Gm. of material, by Guntz's method, gave the necessary conditions and experience for the preparation of Radium. The amalgam was obtained by electrolysis of a solution of

0.106 Gm. of perfectly pure Radium Chloride with cathode of mercury (10 Gm.) and anode of Platinum Iridium. After electrolysis, the solution contained 0.0085 Gm. of the salt. The amalgam was quite fluid, whereas with Barium under similar conditions it is partly crystalline. The dried amalgam was transferred to an iron boat and heated cautiously in a quartz tube in a current of pure hydrogen, purified by passage through the walls of a Platinum tube heated in an electric furnace. The temperature of the boat was determined by a thermocouple. Most of the mercury was distilled at 270° . At 400° the amalgam became solid, and its melting point rose progressively as the mercury was driven off to 700° , when no more mercury volatilised, but the Radium itself commenced to volatilise and to attack the quartz tube energetically. The boat now contained a brilliant white metal, fusing sharply in the neighbourhood of 700° , which was considered to be pure Radium. It adhered strongly to the iron, and blackened immediately on exposure to the air, probably forming the nitride. A particle falling on white paper produced a blackening analogous to a burn. The metal decomposed water energetically, and dissolved for the most part, showing that the oxide is soluble. The small, black residue (? nitride) dissolved completely in a very little Hydrochloric Acid, showing that no Mercury was present. The penetrating rays from the boat containing the metal, sealed in a glass tube, showed the normal increase following the law of production of the emanation. Owing to metallic Radium being much more volatile than Barium, it is proposed to purify it by sublimation in a vacuum.—J.C.S.A. ii./10, 816, ex Mme. Marie Curie and M. Andre Debierne. Compt. Rend. 1910, 151, 523-525.

The element is a member of the group of alkaline earth metals.

Sources of Supply.

Radium Salts are produced in this country. The late Sir William Ramsay devised a method of extraetion which has speeial features in the way of time-saving. The Cornish supply of Pitehblende, which eomes from the Trenwith Mine at St. Ives, has been stated to be rieher in Radium than that found in Joachimsthal in Austria. Pitehblende contains upwards of fifty different elements and is the chief souree of Uranium* which is used in the arts for making the fluoreseent uranium glass and for painting on poreelain.

Radium so far has always been found in eompany with Uranium eompounds.

Sir Wm. Ramsay stated (Brit. Assn. Address, 1911) that the production of Radium would never surpass $\frac{1}{2}$ an ounce a year but this estimate now appears too low.

Carnotite, which contains Uranium and Vanadium, from Ameriea and Australia and **Autunite** from Portugal and China are now sources of supply, also **Torbenite**, but these minerals are by no means so rich in Radium. Carnotite usually contains the equivalent of about 10 mgr. $\text{RaBr}_2 \cdot 2\text{H}_2\text{O}$ per ton.

Autunite (from Portugal) is eomparatively rich in Uranium but mueh eontaminated with soil. The ore contains from 1 to $1\frac{1}{2}\%$ of Uranium and from one ton of sueh material about 2 milligrammes of Radium Bromide ean be produed. **Discussion of the cost of production of Radium.**—P.J. i./14, 59.

Coal has been suggested as a possible souree. Radium has been traced in eoals found in Alabama.

* An account entitled "Chemical investigations of Uranium, a newly discovered metallic substance," by Prof. Klaproth, will be found in the "British Critic," May to August, 1793

A lode containing Pitchblende found on the Kingswood Estate, Buckfastleigh, S. Devon. Uranium Oxide content 26%.—J. R. S., *Apl.* '19, p. 28.

Radium Bromide $\text{RaBr}_2 = 385.84$ in the pure condition is the salt mostly used for medical and general scientific purposes. This salt occurs in hard, yellowish, crystalline particles, and is best kept in hermetically-sealed containers so as to exclude moisture, for reason explained later.

Radium Carbonate by its insolubility, suggests itself for coating Applicators for therapeutic use, *q.v.*

Some probable chemical properties of Radium and its combinations. Radium Hydroxide will be a little more stable than Baryta, but a little more easily dissociable than Sodium Hydroxide; the oxide RaO should be easily converted into the Peroxide RaO_2 at a red heat, and Radium Carbonate should be decomposed with some difficulty at a red heat. The existence of a Hydride (RaH_2) is also predicted.—*Na. Jan.* 1911, p. 395.

Becquerel in 1896 commenced the experiments which led up to M. and Mme. Curie's discovery of Radium by finding accidentally the radio-activity of Uranium-Potassium Sulphate. It was thought that possibly "X" rays always accompanied fluorescence, as they seemed to result from the fluorescence of the glass in the old form of "X" ray tube.

A photographic plate, however, in Becquerel's hands was affected by the Uranium compound through a sheet of copper in the dark without any previous "lighting" being necessary to produce fluorescence. This result had, in fact nothing to do with fluorescence; it was a general property of Uranium compounds, *i.e.*, their radio-activity, whether fluorescent or not. Whilst Uranium will fog a photographic plate in some hours, Radium will produce a like effect in a few seconds. The radio-active energy of Radium may be taken to be about 2 million times that of Uranium.

M. and Mme. Curie concluded that there must be present in Pitchblende an element many times more radio-active than Uranium. On analysing Pitchblende it was found that the acid group precipitate (containing Bismuth with Polonium) had considerable, but the alkaline earth group (containing Radium) the greatest activity.

Yield of Radium.

Upwards of 0.25 Gm. of pure Radium Bromide from the ton of Pitchblende residues. This approximates statements one finds elsewhere to the effect that Pitchblende contains 1 of Radium in 5 million parts or an ounce in 150 tons. Other minerals yield considerably less.

A CHEAP AND RAPID METHOD OF EXTRACTION FROM PITCHBLEND.—100 kg. of finely ground Pitchblende with 400 kg. concentrated crude sulphuric acid are heated for several hours. The mixture is then boiled with from 10 to 20 times the quantity of water, left to stand, decanted and the residue washed with water and the liquid filtered off. The dry residue (about 45–50 Kg.) is heated with 140 Kg. of commercial caustic soda in an iron crucible till a uniform mass is obtained, *i.e.*, in about 1 to 2 hours. This is afterwards boiled several times with about 1,000 litres of water, left to stand, decanted and filtered. The moist residue is then boiled with 5 Kg. of 20% sulphuric acid solution, filtered and washed with water. Raw sulphates of Radium to the amount of 0.5 Kg. are thus obtained,—these can be quickly converted to chlorides by melting with alkaline carbonates, washing thoroughly with water and dissolving the residue in pure hydrochloric acid.—*P.J.* ii./10, 453.

The World's total supply (since 1898) is about 120 Gm.—J. R. S., *July*, 1920.

Characters of Radium.

Radium should be placed below Barium in the Mendeléeff series and on the same line as Thorium and Uranium (*vide Periodic Table*

These three radio-active elements have the highest atomic weights. Radium is divalent. Its spectrum resembles those of the alkaline earths.

A freshly-prepared Radium Salt has its energy stored up and reaches its highest power in three weeks or so. The element is assumed to contain normal atoms and these in succession become the radio-active ones in minute proportion which are disintegrating. Radium and its disintegration products emit rays which will be described. See 'Atomic Disintegration.'

The rays emitted burn the skin if kept in close proximity for a length of time.

Radium decomposes water into hydrogen and oxygen. Oxygen is converted into ozone. It turns glass in its proximity to a violet colour. Mercury is converted into the yellow oxide.

Electrical Properties of Radium.

The rays emitted by a highly active preparation discharge a charged gold-leaf electroscope even through an inch or more of iron or zinc—5 milligrammes will do this at a distance of a few yards.

This occurs whether the charge on the leaves be + or -. All the three types of radiation from Radium have the effect of ionising air in the electroscope, breaking the molecules into constituent atoms, each of which is electrically charged + or -. These charged atoms collide with the charged gold leaves, and such as are of opposite sign to the charge on the leaves neutralise a corresponding amount of electricity on the leaves.—B.M.J. i./09, 1465. One three thousand millionth of a grain of Radium is easily recognisable by an electroscope.—Soddy.

Tests for Purity.

In examining Radium, a glance at its luminosity in the dark is no criterion whatever as to the value of a sample, as within certain limits contamination with Barium will render it more brilliant.

Good Radium Bromide should light up a screen through several copper coins.—It should make Willemitte fluoresce. It will discharge an electroscope with ease (*vide* above).

Glew's instrument (P.J. i./04, 440; ii./04, 254) for estimation of activity. Consists of an electroscope with ground glass front or window. A positive charge is given to the leaf by means of a charged camel's hair brush. The time this charge will remain (usually a day or two) is noted. Markings are made on the ground glass at certain intervals, and on bringing a known weight of pure Radium Bromide, preferably in a metal box, to within a distance of a yard, the time taken for the leaves to fall is observed. Then if a pure sample causes the drop in sixty seconds it follows that the same weight of another specimen doing the same work in 120 seconds is only 50% pure, and so on.

In this method the β and γ rays are not measured directly (the α rays do not come in at all) as they do not penetrate the metal box. The ionisation of the air produced by this 1% of the total radiation is measured.

A Balance Method for comparing Quantities of Radium.

In making comparisons the best method is to compare the γ -ray activities of the two specimens. If the radium is enclosed in a sealed tube, the γ -ray activity reaches a practical maximum after two months, and the intensity of the penetrating γ -rays emitted serves as a definite measure of the quantity of radium. The greater part of the γ -rays are emitted not by radium itself but by radium C., and recent investigations by Moseley and Makower have shown that about 11.5% of the total γ -ray activity of radium is to be ascribed to radium B. The γ -rays from the latter are on the average much less penetrating than those from radium C., and are completely absorbed by a lead screen 2 cm. thick.

The specimens must contain no meso-thorium or radio-thorium. Both the latter substances emit γ -rays of about the same penetrating power as those given out by radium. Since meso-thorium and radium are always isolated together, and are chemically closely allied, it is impossible to isolate pure radium compoknds from minerals containing both uranium and thorium. The uraninite compoknds at Joachimstahl contain only a trace of thorium, so that the radium from this ore can be obtained practically free from meso-thorium. The electroscope used is surrounded by lead 3 m.m. thick.

The primary β -rays are completely stopped by the lead and the ionisation in the electroscope is due to the more penetrating γ -rays and to the β -radiation to which they give rise. The rate of movement of the gold leaf of the electroscope between two fixed points is proportional to the intensity of the γ -radiation. For details of the apparatus see Rutherford & Chadwick, J.R.S July, 1912.

Radium Standard (International).

This consists of 21.99 milligramme of Radium Chloride made by Madame Curie in a thin sealed glass tube at the Bureau des Poids et Mesures at Sèvres, Paris. Another International Standard made by Prof. Honigschmidt is kept at the Academy of Sciences at Vienna.

Duplicate standards are in the hands of Governments of other countries.

The **British Radium Standard** is kept at the National Physical Laboratory, Teddington. It contains about 20 mgr. of pure Radium Chloride.—B.M.J. ii./13,1597; L. ii./13,1639.

The National Physical Laboratory expresses the activity of specimens submitted in terms of **Metallic Radium** instead of Bromide. *This is preferable to prevent misunderstanding regarding the $2H_2O$ in crystallised Radium Bromide.*

Standard Solution of Radium.—Sealed tubes are made containing 1/100,000 mgr. Radium as metal in 10 Cc.

In estimating radium in samples of its salts, it is necessary to weigh out a small specimen. With a good balance, 10 milligrams should be weighable with an error of not more than 1 p.c. The specimen should be dissolved in 100 Cc. of water, some pure hydrochloric acid being added; of this 5 Cc. should be diluted to 1 litre, making 1 milligram in 20,000 of water, or 1/20,000th of a milligram in 1 Cc. If 1 Cc. be diluted to 50 Cc. the strength will be approximately that required for the electroscope, and a comparison may be made with the standard. To calculate the radium to pure crystallised bromide multiply by the factor $\frac{422.3}{226.4} = 1.865$.

Further details of the apparatus needed and technique for making the tests can be obtained on application to the Hon. Secretary of the Rontgen Society.—J.R.S., Oct., 1912.

The following **Equivalents**, which we have calculated, employing Atomic Wt. Ra. = 226.4, showing the percentage of Radium as compared with percentage of Anhydrous and Hydrus Radium Bromide, will be useful:—

53.4%	Ra =	91.2%	RaBr ₂ =	100%	RaBr ₂ .2H ₂ O.
50.9%	Ra =	86.9%	RaBr ₂ =	95%	RaBr ₂ .2H ₂ O.
48.2%	Ra =	82.3%	RaBr ₂ =	90%	RaBr ₂ .2H ₂ O.
45.6%	Ra =	77.7%	RaBr ₂ =	85%	RaBr ₂ .2H ₂ O.
42.9%	Ra =	73.2%	RaBr ₂ =	80%	RaBr ₂ .2H ₂ O.
37.5%	Ra =	64.0%	RaBr ₂ =	70%	RaBr ₂ .2H ₂ O.

Good Commercial Radium Bromide usually averages about 95% Ra Br₂·2H₂O.

For suggested Standard for the Emanation *vide* Emanation.

Atomic Disintegration.

Radium passes in its change through a series of other bodies

“Any one radio-element like Radium considered any instant among its hosts of atoms most of which are destined to last for hundreds, some for thousands of years, a comparatively very small proportion fly apart every second expelling *a* particles and becoming emanation atoms. Next second a fresh set disintegrates, and so on, *a* particles being expelled, and yet so small a fraction of the whole changing that the main part of the Radium remains unchanged even after hundreds of years.”—Soddy.

In the case of the emanation atoms a much larger fraction change per second, producing more *a* particles, and the active deposit. (The ‘Emanation’ will be considered in more detail later.)

The ‘Radio-Active Constant’ λ represents the fraction of the total of an element changing per second. For the Emanation $\lambda = \frac{1}{500000}$. (Rutherford gives 2.085×10^{-6} (seconds)⁻¹).

The **Average Life** of an atom, *i.e.*, the time in seconds it exists on the average before its time comes to disintegrate, is the reciprocal $1/\lambda$. In the case of Radium Emanation the average life is obviously 500,000 seconds, or 5.7 days. (More recent figure says 5.55 days).

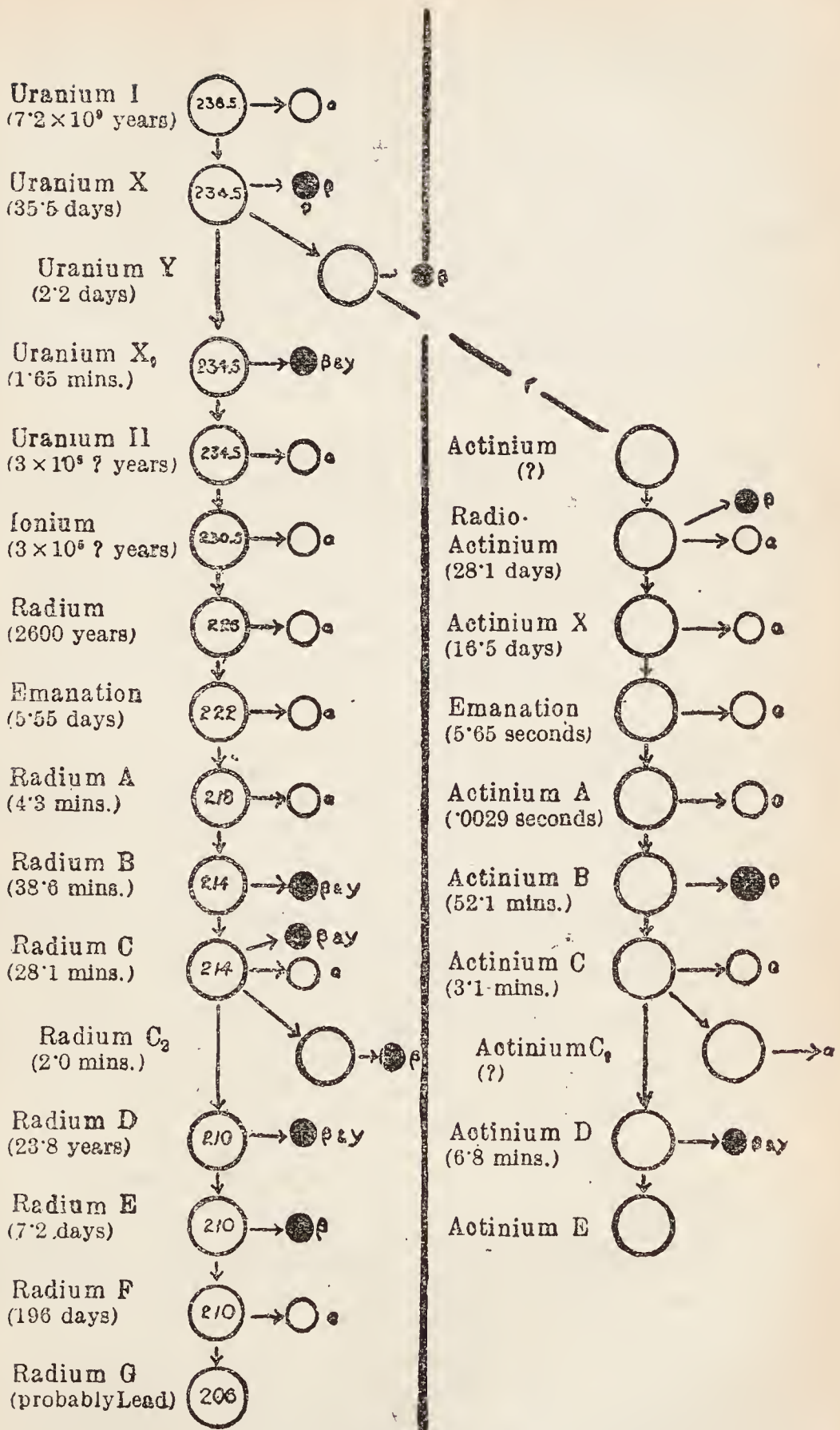
The **Average Life** of Radium is probably about 2,600 years. In other words $\frac{1}{2600}$ part of a given mass of Radium changes annually.

The genetic relation between Uranium and Radium has been established. There is always a definite proportion of Radium to Uranium present in Uranium minerals,—for every 1 part of Radium there always exist 3,000,000 parts of Uranium. $1/\lambda$ for Uranium is 8,000,000,000 years. The average life is always 1.443 times the time τ required for radio-active change to $\frac{1}{2}$ value. Thus the $\frac{1}{2}$ value of Radium is about 1850 years and $1850 \times 1.443 = 2669.55$, *i.e.*, approximately the average life of Radium. For the emanation the average life $= 3.86 \text{ days} \times 1.443 = 5.5 \text{ days}$.

Conversely to find the ‘Half Values’ from the average lives in the table on the following page, multiply the times by $\frac{1000}{1443}$, *e.g.*, the half value of

$$\text{Radium 'B'} = \frac{38.6 \times 1000}{1443} = 26.75 \text{ minutes approx.}$$

It is believed that 1 atom of a radio-active body expels 1 *a* particle only at each disintegration. •

URANIUM TRANSFORMATION DIAGRAM—WITH AVERAGE LIVES (*Rutherford 1914*).

Disintegration of Uranium.

The preceding (Sir E. Rutherford's Diagram, to whom we are indebted for permission to use it) represents graphically the disintegration of Uranium with the average lives of each product.

NOTE.—This table brings the matter more up to date than the table given in a previous Edition. Certain discrepancies are, however, unavoidable. For example, the atomic weights in this table do not agree with those of the International Standard.

Furthermore, the atomic weights given by other physicists differ both from the International Standard and those of Rutherford.

It seemed to us best to allow Sir E. Rutherford's figures to stand in this table with this explanation rather than to alter them. We retain the graphic representation of the transformation as given, as it appears exceedingly clear, interesting and self-explanatory.

Lead is viewed as the end product (Pitchblende invariably contains Lead) and with each change there is an outburst of energy (*c.f.* also p. 316).

Alongside is seen the subsidiary series, showing Actinium and its products. The manner in which Actinium comes to be produced was not known at the time of our last Edn. The recent discovery of the parent of Actinium, namely, *Ekatantalum*, is dealt with on p. 313.

Ionium it will be seen is an intermediate product between Uranium and Radium. For its separation (and Actinium) from certain residues, and the production of Helium by Ionium and by all other products which emit α rays.—See Boltwood, Royal Society.—*Nature*, Mar. 1911, 31. Ionium present in Commercial Uranium Salts is identical chemically with Thorium and cannot be separated from it. Complete similarity of this kind with known elements is one of the features of the chemistry of the radio-elements. There may be more than one of these intermediates.—F. Soddy, Royal Society, P.J. i./12,394. *See also* the Thorium Disintegration Products.

Sir W. Ramsay, in his presidential address to the Brit. Association, 1911, pointed out that taking the Atomic weight of Uranium as 239.4 and Radium as 226.8* (by an experiment), and adding 12 to the latter for the 3 Helium atoms lost during the change from Uranium to Radium, the weight of the Electrons escaping would be 0.6—how many are lost in the change is unknown, though their approximate weight is known, hence it is impossible to make up an equation to show the change, as is the case in many other degradations, *e.g.*,

$$\begin{array}{ccc} \text{Radium} & = & \text{Helium} + \text{Niton.} \\ 226.4 & & 4 \quad \quad 222.4 \end{array}$$

RELATION BETWEEN THE URANIUM AND ACTINIUM SERIES.

The most important advances since our last Edition are concerned with the discovery of the parent of Actinium, which in addition to adding an interesting, chemically new element to those discovered by radio-active methods, completes probably the long sequence of changes suffered by the radio-elements. In addition there have been comprehensive researches on the γ rays of Radium which throw fresh light on the peculiarities seen in the absorption of these

* Note.—It will cause less confusion throughout this chapter to *retain* the weights mentioned by physicists rather than to alter to International weights

radiations and on their wave-length ; and a beginning in the application of the Rutherford-Bohr model nuclear atom to the whole of the elements.—F. Soddy, *Ann. Rep. Chem. Soc.* 1919 (Vol. XV.), p. 195.

Ekatantalum (*Syn.* PROTOACTINIUM). *The Parent of Actinium.*

According to Prof. Soddy, "it was expected that Uranium-Y isotopic with Uranium-X, and Ionium in the Thorium place in the periodic table, and simultaneously formed with one of them in the dual α -ray change of either Uranium I. or Uranium II., would prove to be the first member of the Actinium series. Uranium-Y gives a β -radiation, and therefore its unknown product must occupy the Ekatantalum place in the periodic table and be *isotopic* with Uranium-X₂ or Brevium, the very short-lived product of Uranium-X, in a β -ray change."

There is no reason to doubt that Ekatantalum is the product of Uranium-Y, but this probably, as in the production of Uranium II. from Uranium-X₂, can never be the subject of direct proof owing to the unfavourable relations of the periods. There remains the doubt, however, as to whether Uranium-Y is the product of Uranium I. or Uranium II., although the latter is perhaps the more probable.

With exceptions the complicated disintegration sequences of the radio-elements are now completely unravelled and are indicated in figures reproduced in the *Ann. Rep. Chem. Soc.* 1919 (Vol. XV.), p. 200.

The raw material for the preparation of Protoactinium is the insoluble residue, consisting chiefly of Silica, from Pitchblende after treatment of the mineral with Nitric Acid. It is recommended to add $\frac{1}{2}$ to 1% Tantalum Oxide to the residue and to heat with a little Concentrated Sulphuric Acid and excess of 40% Hydrofluoric Acid in a platinum vessel, properly cooled, then to dilute and filter through a paraffined funnel, evaporate the filtrate, and ignite gently. This renders the Tantalum Oxide containing the Protoactinium insoluble in acids. So far efforts to concentrate it from Tantalum have failed.—J.C.S.A. ii./20, 147.

Isotopes are very closely related elements, chemically inseparable but with different atomic weights. At least six isotopes of lead are known which differ either in atomic or radioactive properties.

Neon is a mixture of isotopic elements of wts. 20 and 22. Chlorine is a mixture of at least two with wts. 35 and 37 and so on.—Aston *Nat.*, Dec. 6, '19, and J. R. S., January 1920, p. 5.

The rate of change of radio-active elements is stated by Oswald in the words "*As time increases in arithmetical progression the quantity of substance decreases in geometrical progression.*"

Chemical Identity of Radio-Elements.

Uranium-X and radio-actinium are chemically identical with thorium mesothorium-2 is chemically identical with actinium ; radium-A is chemically identical with polonium ; radium-C, thorium-C, actinium-C, and radium-E are chemically identical with bismuth ; radium-B, thorium-B, and actinium-B are chemically identical with lead ; thorium-D and actinium-D are chemically identical with thallium.—A. Fleck, *Brit. Assocn.*, 1913.

We deal further with this under **Thorium**. See also **Isotopes** above.

For further consideration of the disintegration Theory see '*Emanation*,' p. 318, and '*Helium*,' p. 320.

Radium rays are of (at least) three main types :—

(1) The α rays, non-penetrating and only slightly deviable in a strong magnetic field, deviation about $\frac{1}{1000}$ part of that of the β particle,—the direction being opposite to that of the β . (2) The β rays, moderately penetrating, deviable. (3) The γ rays, exceedingly penetrating, non-deviable.

When speaking of β and γ Radium rays what are really intended are the β and γ rays of Radium C and C₂. The emanation like Radium itself gives only α rays.—(*vide* diagram *antea*.) The whole of the β rays result in the later changes of the 'active deposit.'—Soddy.

The α rays.

These are demonstrated by Crookes' Spinthariscopes (*σπινθάρις*, a scintillation), and by Glew's Scintilloscope.

Ninety-nine per cent. of the total energy of Radium is due to the α rays, the β and γ being responsible for the remainder.

The α rays from Radium are complex—4 different types, each with a definite 'range' or distance it will travel in any absorbing medium. The most penetrating type according to Bragg travels in air at atmospheric pressure and ordinary temperature 71 mm. (just under 3 inches) and no more. This fact is made use of in a most convincing lecture experiment in which bare Radium Bromide is placed in the centre of a flask coated inside with Sidot's Blende (crystalline Zinc Sulphide), there is no marked effect until the air is rarified by means of a pump—at the first stroke of which the Blende begins to glow.—F. Soddy.

Prof. Joly provides a complete investigation of the ranges of " α " rays in air from various known radioactive elements. They vary, for example, from 70.6 m.m. for Radium C to 27 m.m. for Uranium.—*Na.*, July 20/11, 98.

Barratt, of East London University College, and Marsden, demonstrated by counting scintillations that Thorium B consists actually of two elements, one having the longest range 86 m.m. of α -particle known.—*F. H. Glew*, C.D. ii./12,860.

The fastest α particle is completely absorbed by the time it has travelled only two inches in air. As a general rule this particle travels further in light gases, *e.g.*, Hydrogen, than in heavy, *e.g.*, CO₂. Rutherford and Geiger's method of determining the number of α -particles given out by an element in a certain time and therefrom the atomic weight of the substance formed.—*Rutherford*, P.J. i./13,767.

The α rays are also absorbed by glass, and largely by mica, or a thin sheet of aluminium, or indeed a sheet of note paper. Glass, however, can be blown so thin as to allow the radiation to pass. *Vide p. 315.*

The rays constitute electrically charged atoms travelling at 12,000 miles a second, each α particle being associated with 2 charges of + electricity. Crystalline Zinc Sulphide is very markedly sensitive to the α rays though much less to the β . Barium Platino-Cyanide and Willemite, on the contrary, are more affected by the β than the α rays. The mass of the α particle is about four times that of the Hydrogen atom and is enormous in comparison with that of the particles composing the β rays. The α particle is a Helium atom (*v.* Helium). This accounts for the feeble penetrative power of the former.

The α rays from Radium are readily distinguishable in penetrating power from the α rays from Uranium, and the latter again from those of Thorium.

The β and γ rays from Radium (themselves complex) are different from those of Uranium or Thorium. The differences between the α rays as a class are comparatively small,—the most penetrating α ray

being not much more than twice as penetrating as the least penetrating (α ray).

The 'law of density' governs the penetration of metals and other substances by these rays, the absorption being proportional to the density. Tin, however, is an exception both for the α and β rays; for the α it is about the same as aluminium, and for the β it is about three times as opaque as its density would indicate.

The question as to mass, or volume, of the preparation comes into consideration in the case of the α rays,—the more the surface is spread out the less absorption there is of α radiation by the substance itself. The α rays from 1 mgr. of Radium produce more electrical effect than the β and γ rays from 30 mgr., *e.g.*, in discharging a silk tassel.

Rutherford has shown that at the point where the α particle is no longer detectable it is still travelling at 5,000 miles a second. Beyond this fluorescent and electrical actions all cease simultaneously. It follows that α particles expelled at a velocity below 5,000 miles per second cannot be detected, doubtless there are such changes akin to radio-activity which may be proceeding without our knowledge.

All substances absorb α rays proportionally to the square root of the atomic weight of the substance, if elementary, or to the sum of the square roots of the weights of the constituent atoms, if a compound or mixture.—F. Soddy, *Radio-elements*.

All α particles have the same mass and differ only in the initial velocity of expulsion whether expelled from Radium emanation, uranium, thorium, or any other bodies which expel them.

Rutherford has succeeded in detecting Helium outside a sealed thin glass vessel containing Radium in vacuo—the glass being thin enough to allow the α particle to pass—this being a further point towards proof that the α particle is an atom of Helium. He has also counted the number of α particles expelled from a given quantity of Radium every second. A milligram emits 136 millions per second.—Soddy.

The α particle carries two atomic changes of positive electricity, *i.e.*, it is a divalent ion.

The speed of α particles is such that the life of each α particle is completed in about 1/1,000,000,000 second.—Sir W. H. Bragg. 'Radio-activity as a Kinetic Theory of a Fourth state of matter.'—Na. Feb. 9/11, 491.

"Method of Chemical Analysis." Sir J. J. Thomson at the Royal Institution, April 7th, 1911, demonstrated a new method based on the deflection of positive electrical rays. A photographic plate contained in a special form of dark slide may be used in place of Willemite Screens to demonstrate positive rays, giving thus permanent records. For details, *vide* Edn. XV., p. 681.

Two new gases were detected by Sir J. J. Thomson, by the method from specimens of residues from Liquid Air in addition to Xenon, Krypton, Argon, Neon. Suggestion that one may be H_3 , the other had Atomic Weight 22.—Na., Feb., 1913, p. 645 and 663; C.D., Jan. 25th, 1913.

Polonium, another radio-active element discovered by Mme. Curie in Pitchblende, gives off the α rays almost exclusively.

Using a preparation of Polonium small enough it is possible to reduce the impacts of the α particles to 1 or 2 per second. A preparation mounted on a copper plate 2 mm. in diameter emitted 1,800 α particles per second.—J.R.S., July/o8, 126.

Polonium is identical with Radium F. It has a half value of about 140 days. Polonium and Radium are present in a ratio of 1 : 5000.

The quantity of Polonium in a Radium mineral is 1 mgr. of Polonium for every 14 tons of Uranium.—F. Soddy, 'Radio-Elements.' For Mme. Curie's method of extraction, see *Nature*, Feb. 24, 1910, p. 509.

Since Polonium is the last of the active products in the radium series it is to be expected that it should be transformed into helium and lead, one atom of helium and one atom of lead from each atom of Polonium—this point of view is further substantiated by the fact that before the formation of Radium F. seven *a* particles are successively given off, each of which being an atom of helium has the atomic weight 4. Therefore the atomic weight of polonium would appear to be $(4 \times 7 =) 28$ less than that of uranium, *i.e.*, $238.5 - 28 = 210.5$ —this loses an *a* particle, *i.e.*, 4, giving a final atomic weight of 206.5—a value very close to that of lead.—Rutherford—*Nature*, Feb. 24, 1910, p. 491. *C.f.* also *L.i.*/10,661.

Polonium (occurs with Ra in the Trenwith ore) chemically analogous to Selenium and Tellurium. Taken internally remains in the system some time—finally all of it is excreted.—Sir W. Ramsay, *P. J.ii* /13,823.

For further information regarding Polonium see previous Editions.

The *a* particles expelled in any one type of disintegration travel with exactly the same velocity—which is gradually diminished to exactly the same extent for each particle in passage through a homogeneous absorbing medium, until the "**critical velocity**" 2.7% of that of light is reached. The ionisation produced in any given length of its path *increases* as the velocity of the particles diminishes down to the critical velocity, when all effects cease abruptly and the *a* particle is absorbed or passes beyond range of detection. The *range of the a particles* is, therefore, an important constant.—F. Soddy, 'Radio-Elements.'

The "*a*" ray theory of the Aurora Borealis.—*Na.*, Aug., 1911, 213.

For the *Medical Use* of the *a* radiation *vide* later, p. 330 *et seq.*

In **Luminous Paints** composed of Radium and Zinc Sulphide the Zinc Sulphide undergoes rapid deterioration—the rate of decay in luminosity is proportional to the amount of Radium present, but not exactly proportional. Radium paint made according to **Admiralty Specification** containing 0.4 mgr. of Radium Bromide or its equivalent (in 1 Gm. of Zinc Sulphide) has a luminosity of about 0.03 foot candles, while a paint containing half this amount of Radium is more than half the luminosity. The sample containing 0.4 will die at a much more rapid rate than the other—the weaker preparation has a *much longer life*. This is not generally known. In the manufacture of radium paint the *a* particle is by far the most effective to use for bombarding Zinc Sulphide.

The *a* particle from **Thorium 'D'** has a longer range, 8.6 cm., than that of Radium (7 cm.)—the *a* particle will travel through this distance in air in not exceeding 1/1000th of a millionth of a second. The particle in question from Thorium 'D' is therefore more effective in producing luminosity, but against this is the disadvantage of the relatively short life as compared with Radium. If Mesothorium had a life equal to that of Radium, the half period of which is 2,000 years against 5.5 for Mesothorium, it would be advantageous to use it. **Old samples of Radium are better than others for making paints.—The explanation being that old Radium is richer in the disintegration product 'F'—Polonium**—in fact the *a* radiation of Radium increases for the first 100 years. Ionium would be an ideal excitant—the radiation from this consists of *a* particles only and its half period is even longer than that of Radium.

The **Presence of Mesothorium** may be detected by a special form of **Glew's Scintilloscope**—the scintillations from Thorium occurring in *pairs* due to the fact that when Thorium emanation disintegrates it gives out an *a* particle by reason of which it becomes changed into Thorium 'A,' which in its turn in the fifth of a second gives out another *a* particle.

In making Radium paint the best method is to place a little of the mixed powder in a watch glass in a heap, moisten it with Turpentine and then add about an equal amount of Mastic Varnish and apply with a sable brush, taking care that the crystals of Zinc Sulphide are not broken.—F. Harrison Glew, A lecture on Radium and other Luminous Compounds.

Professor Sylvanus Thompson in discussion dwelt on the question of the parentage of Uranium. This is a profound mystery, but it ought to be possible to reconstruct from Uranium whatever it is that it originally came

from. He had tried all sorts of means—heat and cooling these “lower substances” and bombarding them with “X” rays without success—but it is not impossible.

There is no advantage commensurate with increased cost by increasing the Radium content above 0.2 or at most 0.3 mgr. per Gm. of Zinc Sulphide.—Abst. Ann. Rep. Chem. Soc. 1919 (Vol. XV.), p. 221.

Spodumene, a native form of lithium, exposed to radium rays is luminescent on warming. **Balmain's Paint** (Calcium Sulphide) is improved by the presence of traces of bismuth.—J. H. Glew, C.D. June 17/16.

Chemical action of α -rays on Hydrogen Sulphide, Ammonia, Nitrous Oxide and Carbon Dioxide. The last is only very slowly decomposed.—J.C.S.A. ii./20, 214.

The β Rays. **Actinium** Degradation products give off this type of radiation. β rays—*c.f.* Table *antea*—are deviable in an electric field. They consist of electro-negatively charged electrons (not atoms of matter like the α particles), infinitely smaller than the α atoms, and have a mass about $\frac{1}{1836}$ that of the hydrogen atom. This does not mean weight—it refers to inertia.

The β rays are 100 times more penetrating than the α rays, being reduced to half value by passage through 0.05 Cm. of aluminium. They are, however, *absorbed for the most part by a m.m. of lead*. For further reference to Actinium *c.f.* pp. 311, 312.

3 or 4 m.m. of Aluminium or 1 inch of cardboard is sufficient to absorb all β rays, while γ rays have been shown to pass 20 Cm. of Lead or 2 feet of iron.—Rutherford, P.J. i./13,797.

The average velocity of the particles of the cathode rays in a Crookes' tube is 5,000 to 10,000 miles per second, that of the fastest of the β particles of Radium is as high as 170,000 miles per second, *i.e.*, approaching that of light, but in addition there are various types of “soft” feebly penetrating slowly travelling β rays—Soddy distinguishes these by brackets—(β) rays.

The α and β rays “ionise” the gas through which they pass, making it capable of conducting electricity. The Hon. R. J. Strutt has devised a **Radium Electroscope** for showing the dissipation of the negatively charged rays. We described this apparatus fully in earlier Editions.

We described this apparatus fully in previous Editions, *c.f.*, *e.g.*, Edn. XII., p. 619.

Silver (*q.v.*) emits a secondary radiation very similar to the radiation from Radium, *c.f.* Sir J. J. Thomson's lecture, p. 290.

The γ Rays usually accompany the β rays, *i.e.*, analogous with the “X” rays which are produced by and accompany Cathode rays,

γ rays, according to Rutherford, are identical with ‘X’ rays except as a rule far more penetrating.—P.J.i./13,797.

The γ rays are given off by Thorium and Uranium also, and are about 100 times more penetrating than the β , being reduced to half value by 6 to 7 Cm. of glass or aluminium; they will pass through almost everything, even 7 centimetres of lead before being reduced to 1% of their original strength. According to Rutherford they can be detected after passing through 20 Cm. of lead. The quantity of these (γ) rays must be so small that the therapeutic effects cannot be due to them.

They are about 10,000 times more penetrating than the α . When γ rays pass through matter, β radiation appears in its place, moving first in direction of the original γ but afterwards scattering in the

ordinary manner of β rays. The penetration and therefore speed of the β radiation thus produced increases with the penetration of the γ radiation to which it is due.

Irradiation of a Colloidal solution of Ceric Hydroxide made by dialysing a solution containing 10% of Ceric Ammonium Nitrate with the β or γ rays of Radium causes first diminution of viscosity and then rapid increase—to a clear jelly.—*Abst. Ann. Rep. Chem. Soc. 1919 (Vol. XV.), p. 222.*

Heat Evolution.—Half a grain of Radium Bromide evolves, according to F. Soddy, about 2 calories of heat every hour,—in 4 years 70,000 calories. Half a grain of coal gives out during complete combustion only about 250 calories so that in the period in question (4 years) Radium emits nearly 300 times the energy obtainable from the same weight of coal. In the combustion of carbon, *i.e.*, the chief constituent of coal, more energy is obtained from a given weight than in almost any other change known. N.B.—The coal is rapidly consumed and burnt into oxidation products. 98% of the heating effect of Radium is due to the α particles.—Rutherford has shown.

The temperature of Radium can be shown to be always slightly higher than the surrounding atmosphere. This heating is due to the enormous energy produced by the atoms disintegrating.

Radium Emanation. *Syn. Niton (Ramsay) = 222.4.*

Radium gives off a gaseous emanation allied to the Argon family. According to Sir William Ramsay it should occupy one of the two vacant places in this group in the periodic table (*q.v.*). It is inert,—not capable of absorption by chemical means. The Emanation (a gas) disintegrates in definite stages, and in doing so gives out the various rays—*see* Diagram, p. 311. It is void of chemical activity, and follows Boyle's law.

Accurate determinations of the density of Radium Emanation by Sir Wm. Ramsay and R. W. Gray recently showed that its true atomic weight is 222.5, this being deduced from the disintegration-theory, the atomic weight of radium itself being 226.5, and that of helium, expelled as α particles, being 4. The name *niton* is proposed for the radium-emanation, as being one of the inactive gases, taking its place in the series after *xenon*.

It boils at -71° C., and its critical temperature is 211° absolute.

The gas is given off without appreciable loss of weight of the original matter, and can be aspirated through a tube and be made to condense at -150° C by freezing with liquid air.

It causes Willemite to glow brilliantly in the dark. It can be filtered through wool as distinct from cathode particles, *v. p.* 286. It was found by Sir W. Ramsay and Prof. Soddy to give the helium spectrum on keeping three or four days; in fact, the emanation changes into helium, *i.e.*, the α particles *vide antea*

Ramsay found that in 3.7 days the amount of luminous gas was only half its original size, and in thirty days it was only the smallest pin-point in the tube.

This reduction in volume is concurrent with the change from the gaseous to the solid state (*c.f.* graphic representation). When a Radium Salt is dissolved in water and the liquid evaporated to dryness, the Radium will be found to have lost the greater part of its radio-activity, *i.e.*, the *intensely radio-active Emanation* will have passed off on dissolving in the form of a gas, unless steps are taken to prevent its disappearance. The β and γ rays will have disappeared, and the α rays would be only a quarter as powerful as initially—the activity, however, gradually recovers in a month. The Emanation changes into Radium A, and this into Radium B. The *same amount* of Emanation is in existence whether separated or not. But while the de-emanated Radium goes on slowly producing and storing up more emanation until in about 1 month it has regained its maximum activity, the emanation which has been separated from its parent goes on decaying, losing about half its strength in about 4 days and falls to nil in about a month. There is thus an equilibrium between the quantity of emanation produced and the quantity decaying.—F. Soddy.

The Emanation decomposes water, hydrogen being 3% in excess and will cause the gases to recombine.

The volume of Helium produced from 100 volumes of emanation is about $3\frac{1}{2}$ volumes, agreeing with the view that the α particle is a Helium atom.—Ramsay

The Emanation is an exceedingly *dense* gas, denser probably than Mercury—it has, therefore, a very heavy atom. Its Atomic Weight is probably 4 units below Radium—*i.e.*, it is the fourth heaviest known.

The energy of the Emanation is three times as great as the Radium from which it is obtained. Radium freed from Emanation still gives out α particles (though only about a quarter as many as before). These are regarded as being produced from the Radium atom in the same change as that in which the Emanation is produced. The Emanation is regarded as Radium that has lost one α particle. A pint of Emanation obtained from $\frac{1}{2}$ ton pure Radium would radiate energy of a hundred powerful arc lamps. No known vessel could hold it—it would be instantly melted and dispelled into vapour.—F. Soddy.

An atom of Helium and an atom of Emanation are simultaneously expelled when an atom of Radium is disintegrated, but when the quantity of Emanation has reached its maximum it does not accumulate further with further lapse of time.

It is unwise to keep Radium in solution in a sealed vessel, as the gradual production of Hydrogen and Oxygen may ultimately cause it to burst.

Carbon Dioxide, also Ammonia and Hydrochloric Acid are decomposed.—Ramsay.

The Emanation is absorbed by cocoanut charcoal (*q.v.*) at ordinary temperature and pressure. On heating the charcoal the emanation is driven off, and can thus be concentrated. This has been used for extracting the Emanation always present in the atmosphere.

Standards for Radium Emanation.

The unit of Emanation to be called the '**Curie**' and to be the quantity of emanation in equilibrium with 1 Gm. of Radium (element) with the subdivisions '**Millicurie**' and '**Microcurie**'—the millicurie being equivalent to 1 mgr. and the microcurie to $\frac{1}{1000}$ mgr. on these lines.—J.C.S.A. ii./11,8; B.M.J. ii./11,894. *c.f.* p. 308 *et seq*

Other more or less arbitrary standards not now officially recognised are the **Gram-second** and **Milligram-minute**. The former is the amount of emanation freed from 1 Gm. of Radium element during 1 second.

The **Mache Unit** used for measuring the small amount of electricity in certain radio-active waters depends on the saturation current leak through an electroscope due to the emanation and its products Radium A and Radium C. *It is the quantity of radio activity which causes a leak of $\frac{1}{1000}$ of an electrostatic unit of current intensity.*

An atmosphere of 1 Mache per litre contains 1 part of Emanation in 500 billion parts of air! This minute quantity would seem impossible to produce physiological effect, but enormous energy is involved.—B.M.J. ii./11,894

The Mache Unit is a minute one whereas the Curie is a large one. The emanation combined in 10 litres of Mineral Water moderately radio-active is of the order 0.1 Microcurie.

The Units compare as follows:—

Curie	Millicurie	Microcurie	Milligram-minute	Mache.
1	1,000	1,000,000	7,992,000	2,500,000,000
0.000001	0.001	1	7.992	2,500

—B.M.J. i./13,181.

1 'Electrostatic Unit' = 1,000 Maché Units. *c.f.* B.M.J. ii./13,1107.

Induced or Excited Radio-activity.

Solid substances in the immediate neighbourhood of a Radium Salt acquire **Induced Activity**. After removal the activity decays abnormally rapidly at first, but subsequently in geometrical progression: $\frac{1}{2}$ value 30 minutes. Induced Activity consists of α , β and γ rays. It is in the form of an "Active deposit." In this active deposit changes take place several times in quick succession. The bodies are termed Radium A, Radium B, Radium C, Radium C₂, and Radium D. *C.f.* graphic representation.

In the case of **Thorium** the induced activity lasts a few days, whilst that of Actinium decays slightly more slowly than that from Radium.

For method of collecting active deposit from Radium, etc., emanations, see F. Soddy, 'Radio-Elements.'

Willemite fluoresces under its influence. Secondary β radiation may be well shown (Glew) by placing a tube of radium above a photographic plate face downwards on a piece of metal, *e.g.* Platinum covered by a piece of black

paper; there results darkening of the plate, the image being the image of the Platinum sheet taken, and if thin Platinum foil be used images of objects placed beneath it can also be obtained. The photographic efficiency of this secondary radiation is greater than that of the primary radiation which has already passed once through the film.

The hardness or penetrability of secondary rays produced by impact of Radium rays is governed by the Atomic Weight of metal giving rise to them.—F. H. Glew, J.R.S., Oct., 1912.

Helium (He=4) is occluded in various minerals especially those of Uranium and Thorium. This suggested to Ramsay and Soddy the investigation which led to the proof that radium emanation is in part helium.

In some instances its volume is nearly 100 times as great as the volume of the mineral from which it was obtained.

Helium has been liquefied at -270°C. , i.e., only 3° from the absolute zero.

Helium is one of the ultimate products developed by nature from Radium, Uranium and Thorium, formed slowly but, nevertheless, fast enough to ensure that all minerals containing these elements must contain Helium also. The α particle from Radium is an atom of Helium (*vide a Rays antea*).

Taking the atomic weight of Helium in round number as 4 this inert gas fits in with other members of a like nature, viz., Neon At. Wt. 20, Argon 40, Krypton 83, Xenon 130.

50 mgr. Radium produce 0.000018 mgr. Helium in 60 days, or 0.0022 mgr in 1 year from 1 Gm. of Radium Bromide.—Chem. News, May 27, 1904.

Dewar differs from Ramsay as to yield of Helium from Radium. Dewar finds only 0.37 C.m.m. from 1 Gm. per diem which approximates Rutherford's forecast. Na., November 5/08, 29. See also C.E.S. Philips Pres. Add., J.R.S., Jan., 1910—(0.159 C.m.m per Gm. per diem). Ramsay found 3 C.m.m. per diem

F. Soddy detected the production of Helium from Uranium and Thorium—the amount is 1/500,000,000,000 of the Uranium or Thorium per annum which accords with theory. The method of detection depends on the use of strongly heated Metal Calcium, which *in vacuo* absorbs all gases except Helium.

About 2 mgr. of Helium are produced from 1,000 tons of Uranium per annum.

It is possible to draw conclusions as to age of geological formations from the accumulation of Helium in them.—R. J. Strutt, Discussion, Na., Oct. 27, 1910, p. 543; Nov. 3, 1910, p. 7.

The question as to whether helium is held *mechanically* or *chemically* in radio-active minerals has been discussed, the former view being supported by the fact that grinding liberates about 28 per cent. of the gas. Experiments upon the growth of radium from uranium at Glasgow, and Professor Rutherford's forecast, that its production should be proportional to the square of the time verified.—J.R.S., Jan., 1910.

War and Commercial Use of Helium.

Helium is present in gases, minerals, springs—at some springs in France as much as 5% is present. Prior to 1918 the total amount isolated did not exceed three or four cubic metres. It is twice as light as Hydrogen (the atmosphere being 14.4), enters into no combinations, and is quite inert: it is non-explosive. It was suggested in 1914 to fill envelopes in air ships instead of Hydrogen. Its rate of diffusion through the envelope is 30% less than that of Hydrogen, while its lifting power is 9.6 times as great. In Ontario in the gases yielded by the various oil wells along the Grand River an average of 0.33% of Helium is found. At Bow Island a supply of 10,500,000 cubic feet is available annually. It is conveyed by pipes 160 miles long to Calgary and there used for various purposes. In the Calgary Station first Nitrogen with a content of 5% Helium is obtained, while liquid Methane, Pentane and Butane are also produced in large amount. By submitting this 5% Helium to a temperature of -163 at a pressure of 25 to 30 atmospheres Helium of 87 to 90% purity is isolated, and this can be further purified by means of liquid air. Hydrogen with a content of 20% Helium is still non-inflammable.—Prof. J. C. McLennan, J.C.S. July 1920, 923; C.D. '20, 845; L. i./20, 164; Na. May 20/20 p. 360; Aug. 12/20 p. 747.

Transmutation of Hydrogen.

Norman Collie & Patterson independently found indication of **production of Neon & Helium from Hydrogen** on subjecting the latter to bombardment by Cathode rays. This, if correct, would be a case of *synthesis* in contradistinction to breakdown as in the disintegration of Radio-active bodies.

The details of the experiments are as follows:—Sufficient Hydrogen to conduct an electric discharge is admitted into a vacuum tube. Helium appears after sparking a short time. If the vacuum tube is surrounded by another containing a little Oxygen both Neon and Helium are found in the space between the two tubes. The formation of Neon is apparently conditional on the presence of Oxygen. The authors say there is no possible error in the experiment.—B.M.J. i./13, 304, 360

There have been indications that Radium or Niton causes an absorption of energy sufficient to disintegrate what are probably exothermic elements into elements of lower atomic weight.

Sir William Ramsay found that on treating water with Radium Emanation he obtained Neon in addition to Helium. The equation $\text{He (4)} + \text{O (16)} = \text{Ne (20)}$ may be the explanation.

In Bath waters there is three times as much Neon as Helium, Niton decomposing in the bowels of the earth and the nascent Helium uniting with the nascent Oxygen to form Neon

Sir Wm. Ramsay also showed the production of Argon when Sulphur and Hydrogen are subjected to Cathode Rays for 4 or 5 hours and of Krypton when Selenium and Hydrogen are treated in the same manner. He viewed the change of Hydrogen to Helium as polymerism. It is possible that Xenon may be formed by action of Cathode Rays on Tellurium in presence of Hydrogen.

Copper Salts under influence of radio-energy yield, it is said, distinct traces of Lithium (*c.f.* Sir Wm. Ramsay, Chem. News, Sept. 1/11.)

With regard to the transmutation of Hydrogen into Helium and Neon in an "X" ray bulb, the points to be decided are whether the new gases are the direct products of electric energy (an "X" ray tube can take the place of Radium irradiation) or whether it is merely a question of occlusion in the bulb or a transmutation of Hydrogen or Aluminium of the Cathode.—Na. Feb. 13, 1913, p. 653; B.M.J. i./13, 1224; L. i./13, 472; C.D., Feb. 15, 1913.

Professor Collie says he is satisfied that Neon and Helium have been produced from substances which were previously not present; In the case of Radium the degradation cannot be hastened or checked, but this artificial production of Helium and Neon is at the other end of the system—at the bottom of the list of low and of the lowest Atomic Weights.—C.D., Feb. 15/13.

Sir J. J. Thomson writes that the method employed by him for producing the gas X_3 (or H_3) that gave the best yield was one of bombarding metals and other substances with Cathode Rays—Helium was obtained in this manner from Platinum and Lead.—Na., Feb. 13/13, p. 645.

Prof. F. Soddy refers to a previous paper in which he traced the Helium in vacuum tubes to the Aluminium electrodes.—Na., Feb. 13, 654.

Hon. R. J. Strutt has been unable to confirm the work of Collie and Patterson. This may be due to the difficult conditions of the work.—C.D. i./14, 84.

The Ratio between Uranium and Radium in Autunite.

Autunite specimens from various parts.—Autun in France, Guarda in Portugal, show much less Helium than the equilibrium amount would demand—only 27%, 44%, etc. Dual measurements of the radium ratio and of the helium content of several specimens of Portuguese Autunite have shown that both vary considerably for different specimens of the same mineral. Prof. Piutti ("Helium in Recent Minerals" *Le Radium* 1910 vii. 178)—found that Autunite was the only radio-active mineral in which helium could not be detected. F. Soddy writes that he has only failed to find Helium in one specimen of Autunite. An almost pure crystal of Autunite weighing 2.3 Gm. and of so fresh an appearance that it looked as if it had been recently withdrawn from its mother-liquor, and a second an obviously older looking, greener, and much larger mass containing 46% of matric were examined. The first gave a radium ratio of 70%, and in it Helium could not be detected. The quantity was not greater than 0.002 c.m.m. per gram Uranium. This quantity would form in about 30 years only! For the second, the Radium ratio was 44% and the Helium 0.035 c.m.m. per gram Uranium, which would be produced

in about 600 years. Lastly, one of the Autun specimens for which 27% for the Radium ratio had been found, contained more than 0.15 c.m.m. Helium per gram Uranium, some being lost. The radium ratio therefore appears to decrease to a minimum and then rises more slowly as the helium content increases. If the latter is taken as a measure of the age of the mineral, the minimum appears to be reached after a few thousand years. This is exactly what would occur if, when the Autunite was formed, the radium (but not its parent) associated with the uranium in its former condition separated with the latter. This is probable, owing to the isomorphism of radium and calcium. But we have here a somewhat startling result if initial radium can have any influence on the amount present in a mineral to-day, for this necessitates that the ages indicated by the helium content are not altogether below the truth and that these crystals are actually even now in full process of formation.—Na., Sept. 8/10, see also paper International Cong. Radiology & Electricity, Brussels, 1910.

Differences between the ratio of Radium to Uranium present in various minerals may be attributed to the existence of the long-period Ionium and possibly another long-period element between the parent Uranium and Radium, but does not exclude the further possibility of the "constants" of radio activity being influenced by external circumstances more than we at present believe.—Na., Aug., 1911, 257.

The duration of geological time suggested by the study of radio-active minerals is of the order of 500 million years.—Na., July, 1911, p. 9.

Beryl is stated to contain abundance of Helium without sufficient radio-activity to explain its presence there.

Radio-activity may be regarded as one phase of the cycle of evolution of matter—the other phase—the construction is infinitely slower. The radio-active phase is virtually the culmination of the long constructive phase during which atomic complexity has increased to such an extent that it eventually leads to instability. Helium being extremely light rises to the upper strata in interplanetary space. *Many of the hottest stars are composed almost entirely of Helium.* According to Carnot's principle, energy cannot pass from a cold to a hot body, but the behaviour of Helium demonstrates an exception to this.—B.M.J. ii./11, 1546.

If the amount of Radium in the interior of the earth is the same as that in the surface rocks the earth ought to be growing hotter instead of being nearly in thermal equilibrium. Prof. Strutt assumes that the earth's store of Radium is concentrated near the surface. Arguments in favour.—A. Holmes, Na., June 19, 1913, p. 398.

Radium in the Atmosphere is present to the extent of 60×10^{-12} Gm. per cubic metre. The air in the upper atmosphere (10 to 50 miles up) has been shown to be considerably ionised, possibly due to the direct radiation from the sun which consists of α β and γ radiations *inter alia*.—Rutherford

Action on Bacteria, Toxins, Ferments, Blood, etc.

The Rays were found to have apparently no action on *B. Pyocyaneus*; similarly in case of *B. Anthracis* except apparently slightly greater tendency to spore formation. *Staphylococcus Aureus* similar result, similarly with the important organism *B. Coli Communis*. There was a slight difference in respect of *B. typhi abdominalis*—amount of Radium not stated—Guy's Hospital Experiments.—L. i./09, 1445.

The fact seems to be clear that Radium Rays are not bactericidal to any extent. L. Barlow, however, detected a bactericidal action and predicted the use of Radium in bacterial diseases in addition to malignant growths.

In a series of experiments upon diphtherial Toxins quantities of Radium Sulphate varying from 20–50 micrograms and the duration of contact with the Toxin being thirty days—with non-radiferous Toxins the "control" guinea-pigs die within from 24–72 hours after inoculation, but the animals inoculated with the radiferous substance survived at least for 5–12 days, and in some cases for 20–30 days. A similar difference between the action of the radiferous and non-radiferous Toxin was discovered with emulsions of the living Koch Bacillus. Radium has no retarding influence, however, on the virulence of Tetanic Toxin. The Tetanus Bacillus being anaerobic—living, *i.e.*, in an environment (the soil)—which is much more radio-active than air and water—acquires possibly a degree of insensitiveness to the radiation.—B.M.J. ii./11, 1025.

Radiation is stated rapidly to destroy the ferments emulsin, tyrosin, pepsin, trypsin and ptyalin.

Blood *in vitro* mixed with Radium emanation. Hæmolysis occurs with gradual conversion of oxyhæmoglobin into met-hæmoglobin. The hæmolysis is due to α -radiation. Leucocytes show marked degenerative changes when exposed to α -rays. The specific properties of opsonin and hæmolytic complement are lost when serum is exposed to α -rays. The progressive changes caused by these rays indicate the separate identity of opsonin and complement. The β and γ rays yielded negative results in analogous experiments.—H. Chambers and S. Russ. Roy. Soc., June, 1911, per Na., June 15, 1911, p. 540.

Radio-active bodies are probably poisonous, acting directly on the nerve centres. If radium emanation were used criminally the excited activity would have to be sought for, and probably would not be found, whereas if an actual radium salt had been administered even the ashes of the dead body would show the necessary radio-activity to convict the murderer.

THERAPEUTIC USE OF RADIUM.

Distance of the Part to be irradiated, from the Radium.

As with light, "X" rays and other forms of Ether vibration, the strength of the radiations *varies inversely as the square of the distance*, e.g., if an object be 1 Cm. from the Radium and another 5 Cm. from it, the latter will only receive $1/25$ the strength of radiation of the former. If the Radium be 5 Cm. from the skin, this and the tissues 5 Cm. below the skin should receive exactly $\frac{1}{4}$ of the radiation received by the surface, but the intensity is greatly diminished owing to absorption. By the use of much larger amounts of γ ray producers Finzi says it will be possible to overcome this difficulty. A screen of 8 m.m. of lead will allow only γ rays to pass, but the proportion of β rays passed by only 3 or 4 mm. of lead can be ignored.

"It has been proved by using rays through 5 mm. of lead which filters out the β rays almost entirely, that the γ rays have a curative action on certain malignant growths."—P.R.S.M. Electro-Therap. Sec., Jan. 1910, p. 53.

Clinical observations afford ground for believing that the borderline between the stimulative and destructive actions of Radium Rays is more rapidly reached in the case of pathological than in the case of normal cells.—Guy Stephen.

Histological changes effected by radiation—initially on normal skin there is stimulation—the nuclei showing enlargement and alteration in shape, the stroma swelling—the more superficial cells may die, the epidermis meanwhile peeling off. The cells lining sebaceous and sweat glands and hair follicles undergo granular degeneration and die too. In the deeper layers normal cells are first replaced by others of embryonic type and these evolve into ordinary connective-tissue cells. Finally, at the end of some months, the general structure is that of fibro-elastic tissue (Barcat and Dominici *per* Guy Stephen). In the case of new growths the changes effected are similar, with exception that the neoplastic cells instead of being stimulated have their vitality lessened; their evolution ceases and clumps of cells undergo necrobiosis—meanwhile normal structures in and around the growth show increased vitality. With regard to the neoplastic cells their decrease is probably due to alterations in the blood supply. In any case if treatment has been successful the site of the original growth becomes occupied by layers of fibrous tissue, or in the case of a more or less circumscribed tumour, by a body resembling an innocent fibroma.

Normal and cancer tissues under Radium behave the same way and selective action doubted.—Bashford.

Experiments by exposing livers of mice to γ Radium Rays through the anterior abdominal wall and subsequent microscopic examination. *Vide* B.M.J. ii./11, 1194, v. also L. ii./10, 462.

Attempt to produce carcinoma in rats by Radium.—W. S. Lazarus Barlow, B.M.J. ii./17,794.

Radium Rays applied directly to the Brain,—using Radium Carbonate equivalent to 27.7 mg. of Metallic Radium and covered with a screen of $\frac{1}{2}$ mm. platinum. This was placed direct on the pia mater over the pre- and post-central gyri of three monkeys, after a trephining operation. In the third monkey a tube containing nearly double the amount was placed on the opposite side and at a subsequent experiment on the occipital lobe—this time $2\frac{1}{2}$ to 4 hours. In none was there the slightest symptom exhibited. Histological results, however, showed the α rays from which the less penetrating β rays have been filtered off, exert no influence discoverable by present methods on nerve tissues, but cause notable changes in the blood vessels. For further details *vide* B.M.J. ii./11,899; L. ii./11,446.

Muscle-nerve preparations of the frog, effects on. Under α rays the irritability of the muscle-nerve preparation was apparently longer preserved than under control conditions, β and γ rays were without effect. Curare treated preparations also discussed. No histological changes found.—Lazarus Barlow, L. ii./12,1508.

Malignant cells are killed in certain number outright, but the beneficial action is as stimulant on the healthy cells.—E. H. Shaw, B.M.J. ii./12,373.

Radium Burns are stated to be cured by Friar's Balsam or Scarlet Red.—Pres., Nov. 1912,289.

Distribution and Excretion of Radium and its emanation after administration.

Experiments on mice showed:—

1. After the administration by mouth or by injection of radium a wide-spread radio-activity is evident throughout the body.

2. Elimination of Radium takes place principally and rapidly by the bowel, in a minor and slower degree by the kidneys, while in mice at all events there is no evidence that the liver or skin plays any part in excretion.

As regards the elimination of the element by the bowels, it is certainly excreted by the small intestine, and there are indications that the large bowel also assists.

3. The high activity in the lungs is possibly due to their extreme vascularity, but its constant presence at all times after inoculation and the fact that the emanation is entirely eliminated by the lungs suggests that an accumulation of Radium takes place with a view to the more ready excretion of the emanation.

4. The emanation can be obtained in solution in various media, and can be introduced into the body in small doses by inhalation, feeding, or by injection.

5. After such administration, and however introduced, a general radio-activity of brief duration is caused throughout the body.

6. Elimination of the emanation takes place principally and almost entirely by the lungs, and to a very slight extent by the kidneys.

7. The duration of the activity induced in the body, or in other words the time taken in excretion, differs with the preparation used. Soluble salts of radium are rapidly eliminated, however given. The insoluble salts *per os* are excreted directly by the bowel and there is no evidence of any temporary absorption. When given by injection, however, slow elimination takes place by the bowel, but the time taken, however, is so great that the salt practically may be considered to be permanently present at the site of injection.

8. The elimination of the emanation occurs with great rapidity and was complete, after administration in powerful doses, in so short a time as four hours.—E. Bellingham Smith.—Qr. Jl. Med., Jan., 1912, p. 249.

Chemical Effects produced by Radiations.

It is undesirable to introduce unprotected Radium Salts (or Thorium Salts) into the system. Apart from poisonous action at any rate of the latter, these may remain permanently in the system and destroy surrounding tissues. Rutherford.

(I.) Radiation from Sealed Glass Tubes (*Mainly*).

Radium Emanation being a gas, and directly concerned in the production of the greater part of the activity of Radium, it is in the highest degree essential that Radium Salts after preparation in their final form, should be kept in hermetically sealed tubes from the air, as otherwise, by the escape of Emanation, much of the activity of the preparation is lost. The glass covering may be made thin, *e.g.*, a **microscope cover glass**.—F. Soddy.

Rodent ulcers of superficial origin, lupus, epithelioma and papilloma have been cured by juxtaposition, *e.g.*, by placing one or more 5 milligram tubes in contact with the part for various successive lengths of time.

Rodent Ulcer.

The late Sir J. Mackenzie Davidson, one of the first workers with Radium in this country, reported many cases of rodent ulcer treated without a failure.—See also H. J. McLeod, P.R.S. Med. Dermat. Sectn., 1909, p. 3.

Rodent ulcer treated by 90 mgr. of activity 500,000 spread over a surface 3 cm. square, and a glass tube containing $\frac{1}{2}$ mgr pure Radium (Bromide)—improvement.—C. J. Symonds, P.R.S.M., Clin. Sectn., May, 1910, 162

Dawson Turner reports on 41 cases treated by Radium during 1912 at the Royal Infirmary, Edinburgh—11 rodent ulcer, 12 malignant diseases, 11 nævi, one leucoplakia, one lymphadenoma, one spring catarrh, one tuberculous glands, one tuberculous ulcer of the dorsum of the hand, one papilloma and one hypertrichosis. Tubes inserted into growths wherever possible and left *in situ* for up to 12 days with simultaneous external use. Of the 11 nævi two were port wine stains, seven cured, three under treatment and one (port wine stain) did not return. Rodent ulcer extraordinarily amenable. Radium is superior to Carbonic Snow or Zinc ionisation or excision, because the rays penetrate deeply—in fact right through the body—so that the very roots of the rodent ulcers are attacked. Secondly, the treatment is painless; thirdly, cosmetic results leave nothing to be desired. Malignant disease hopeful.—B.M.J. i./13,606; L. i./13,817.

The same worker describes further work at Edinburgh. A trocar for introducing tubes.—L. i./17,546.

Malignant Growths (*mainly*).

Sir F. Treves says rodent ulcer, epithelioma of tongue and lip, nævus, port wine stain, pigmented mole, hairy mole, angioma of the eyelids, keloid, known by him, personally, to have been cured.

Inoperable cancer of the cervix uteri treated by the more penetrating Radium Rays with great amelioration—some possibly cured.—L. ii./11,1213.

The only rays that can be usefully employed for malignant growths are the hard β and γ rays—the α and soft β are to be filtered off.—L. ii./11,1337.

Rapidly growing endothelioma of the cheek, successfully treated by radium.—B.M.J. ii./11,1475.

Its value lies in treating diseases other than cancer.—Bashford.—B.M.J. i./11,1221. This worker and Mansell Moullin say it is merely caustic. Others hold that it is specific and selective.

Carcinoma arrested.—T. R. Riddell, B.M.J. i./14,1006. See also further abstracts of papers, in our last Edn.

For further consideration of malignant growths treated by Radium, see Sections ii., iii., and iv., following.

Ocular Therapeutics.

Sir Arnold Lawson and the late Sir J. Mackenzie Davidson reported 46 cases.

Method of Application.—Sealed glass tubes (permitting only β and γ rays to pass) applied direct to affected part—the tubes to be kept in close contact. The eye first cocainised.

Length of exposure.—5 minutes was fixed as being absolutely safe. A tube of 20 to 30 mgr. can be applied to the inner surface of the lid in rodent ulcer affecting the lid border and so lie in contact for $\frac{1}{2}$ hour. No ill effects nor aggravation of symptoms. Pain usually transient. Lesions of the cornea can be treated successfully with five minute dose by the same amount, which for affections of skin and lids required an exposure three or four times as long. Superficial lesions of the cornea can be treated by five or ten mgr. applied once or twice. 20 mgr. is sufficient to combat any external affection of the eye and eyelids in which Radium is likely to be of service. The sears produced—*e.g.* in cases of spring catarrh—are supple and smooth without the slightest tendency to cause cicatricial dragging, but they are very blanched.

In the knowledge of the authors 1 mgr. of pure Radium Bromide in a glass tube was applied to a urethral caruncle for 10 minutes every other day for 10 days, then stopped. *After further 10 days* a slight burn developed and the part healed up completely.—June 9/09.

Combined sclerosis treated by Radium. Patient acquired syphilis at 24. His father had had a sudden paraplegia at 50. Ten years later symptoms appeared. Shooting pains, incontinence, heavy spastic gait, increasing incapacity to hold himself upright. Reflexes of both upper extremities abolished. Analgesia and anæsthesia of both lower limbs. Fibrillary tremor of tongue and finally thoracic respiration became paralysed. Radium applied along the whole length of the spine with improvement. A month after, another application lasting for ten hours: after another month a third. Patient could hold objects and feed himself, execute movements of flexion with forearm and could stand erect for some minutes and walk a few steps.—B.M.J. ii./11, 68.

(II.) Metal Tube (inserted into Tumours) and Metal Screen Results.

Deep seated or deeply extending growths can be cured by Radium radiations from which the less penetrating rays are filtered out. Large recurrent scirrhus of breast and epithelioma of larynx treated with success. 50 mgr. of pure Radium Bromide in silver tube 0.6 m.m. thick advised, placed in two different positions during the treatment. Action at a depth is obtained by using large quantities of Radium and filtering out all the less penetrating radiations and giving long exposures. The question of success with Radium treatment appears to depend on structure and clinical characters.—Finzi.

Scirrhus, inoperable recurrent, treated as above almost disappeared. Considerable dermatitis was produced, commencing almost at once and reaching maximum in 3 weeks. Radium applied for 53 hours.—

Malignant disease, two cases, one of the breast, the other on the lip. Disappearance and improvement respectively.—B.M.J. i./09, 1238.

Deep-seated inoperable cancers treated,—a lymphadenoma apparently cured in 6 months by 5 mgr. contained in a gold cylinder 0.5 m.m. thick. Amelioration of an inoperable sarcoma, employing 50 mgr. in a silver tube 0.5 m.m. thick.—B.M.J. i./09, 1557.

Tuberculous gland after recurrence on removal treated. Long exposure, using for filter 2 m.m. of lead. No trace left after three weeks. The method enables penetration without burning.—Sir Maleolm Morris.—B.M.J. ii./09,286.

At St. Mary's Hospital malignant disease of the gullet treated by William Hill with rays from 50 mgr. passing through 4 m.m. of Lead applied for as long as 17 hours at a time, with the result that the tube in question ultimately dropped through into the stomach. Endoscopic dilatation of an œsophageal stricture is reported on. By this method, in suitable cases of stricture, dilatation by gradual use of bougies and the application of Radium can be carried out with precision.—M.P., Sept. 1/09,225. *Vide also* B.M.J. ii./09,843; ii./11,1074.

Fungating carcinoma of the œsophagus. Treatment by 50 mgr. pure Radium Bromide through œsophagoscope for 13 hours and two months later for 21 hours. Marked improvement in swallowing.—P.R.S.M. Laryng. Sect. Dec. '10,8.

William Hill gave an account of further work in the treatment of malignant stricture of the œsophagus, using his styletted red rubber oro-œsophageal catheter for either permanent or temporary retention. 22 cases of malignant disease of the gullet had been treated using 50 to 20 mgr. of Radium for periods varying from 12 to 28 hours on end, repeated in some as many as 6 times. Four temporary cures, 6 remarkable improvement, 7 substantial improvement, in 5 only no improvement.—L. i./11,506. Utility of Radium and Diathermy compared.—L. ii./14,385.

Carcinoma of the breast in a woman of 78. The disease recurred beneath a scar, the result of previous operation. Two long exposures to the rays of 50 mgr. filtered through a thin silver tube were given and six weeks later another exposure through 1 m.m. of lead in addition to the silver. The first two exposures were excessive and caused small but troublesome burns. The tumour and enlarged gland, however, disappeared, and at time of death were not palpable.—P.R.S.M. Clinical Sect., Nov. '09, p. i.

Finzi describes treatment of over 100 cases of cancer. The Radium must be sealed up. Even if the Radium is separated a small distance from the surface and only the readily penetrating rays are used, as large a dose is given as the skin can stand long before the deep parts receive the maximal dose,—in fact it is only the extreme selective action of the rays on cancer cells that makes external treatment possible at all. Results show in 12% disappearance of the local growth (cases incurable by any other means except, perhaps, a small proportion by "X" rays), but 10% of successes means 90% of ultimate failures or partial failures. Large quantities of Radium must be used (50 mgr. is an absolute minimum for cancer) and metal filters at least $1\frac{1}{2}$ m.m. thick of lead or platinum.—L. i./11,1339.

Malignant growth, either glandular carcinoma or endothelioma, of the cheek disappeared under Radium treatment. Initially a

swelling removed surgically, then a sudden rapid swelling at place of operation to size of an orange. 105 mgr. in two tubes, one surrounded with Platinum $1\frac{1}{2}$ m.m. thick, and the other in lead the same thickness inside the tumour for 69 hours and on lint outside in two situations for 12 hours each. In a month considerable reduction, but there was a pre-auricular gland to be felt,—this was excised and 100 mgr. with a filter of 2.5 m.m. platinum inserted for 9 hours. After three weeks a few nodules left, 205 mgr. applied on lint externally for 30 hours and internally for 9 hours. Subsequently another large dose for prophylaxis. Gradual absorption leaving a depression and scar.—Finzi.—L. ii./11,1479.

Small quantities of Radium do more harm than good, for if the irradiation be not thorough the cells receiving the smaller dose are stimulated not killed in consequence of the increased blood supply produced. With regard to implanting tubes into growths, Mansell Moullin deprecates this on the ground that all manipulations of malignant growths, especially soft ones tend to disseminate them.—L. i./11,1337 et seq.

Malignant disease of pharynx under treatment by 105 mg. Radium Bromide through $1\frac{1}{2}$ m.m. of Platinum or Lead, applied for 35 hours in all, improvement within 48 hours.—P.R.S.M. Laryng. Sect. 1911, 64.

Three cases of malignant disease and varicose ulceration treated to a successful issue by use of tubes containing 250 mgr. Radium Bromide, which for deep-seated cancers were screened with $2\frac{1}{2}$ m.m. of Platinum—left in position from 24 to 48 hours. When possible the tube is inserted into the tumour 48 hours. "Cross rays" also employed. This treatment may be repeated 5 to 6 weeks later. For superficial lesions tubes are used unscreened for half an hour every other day for a week. Best results from large doses screened to the exclusion of all rays excepting the hard β and γ rays applied for a considerable length of time.—B.M.J. ii./11,1529.

Costal caries and fistula consequent on incomplete extirpation of bacillary foci ameliorated of deep extra-pulmonary tuberculous lesions, such as chronic adenopathies, by the introducing into the tissues of silver tubes containing Radium.—L. ii./11,799.

Cancer cells are more powerfully affected by Radium than normal tissue cells. It has selective power on cells of malignant growth. Abdominal tumour, spindle cell periosteal sarcoma on the surface of femur, tumour of tonsil and pharynx, encephaloid carcinoma of testicles, all well treated. Large quantities used—up to 100 mgr.—Sir A. Pierce Gould, B.M.J. i./14,1 et seq. See also L. i./13,218.

Hypersecretion of the Thyroid Gland treated by Radium Rays. Screened by $\frac{1}{2}$ m.m. of silver.—Dawson Turner, L. ii./13,924.

Cancer of the throat. After glands were dissected out four and subsequently three tubes of silver 1 millimetre in thickness—each containing 50 milligrammes, and wrapped in sterile surgical gauze five layers thick were left in the wound, in as close proximity to the ulceration as possible, for 48 hours. Improvement for a time in

the local condition, but the neighbouring parts broke down from septic infection and death resulted.—J. S. M'Kendrick and J. H. Teacher, Glas. Med. Jl., Oct., 1912.

Papilloma of the larynx, 100 mgr. of Radium will cure in 30 nmmites.—Abbe, B.M.J. ii./13,915.

Carcinoma uteri.—Prof. Bumm's report of 108 cases. Nothing so powerful in producing shrinking of primary growth, but the danger is with regard to the masses of carcinomatous cells in the surrounding connective tissue. In cases requiring prolonged treatment the muscular and vascular structures found to undergo fibrosis—leading to a stage not far removed from necrosis. *Small doses (50 to 60 mgr.) better than large. Thick lead filters dangerous owing to secondary radiation. Aluminium and tin filters best—not in direct contact with the growth—a few cm. distant.*—B.M.J. ii./13,1546.

In some growths the caustic action is deliberately used to produce necrosis of the mass in the hope that when the slough separates the normal tissues will fill in the resulting ulcer. Reports on rodent ulcer, epithelioma, sarcoma, cancer of the breast, œsophagus, rectum, cervix uteri and bladder.—R. Knox, B.M.J. i./13,1196.

Inflammatory disease of the uterine appendages treated by Radium. Risk of sterilising the patient. Fibroids better removed surgically.—W. S. A. Griffith, B.M.J. ii./12,1107.

At Middlesex Hospital—from June to September, 1913—out of 68 cases of inoperable cancer 32 discharged apparently cured,—only one or two recurrences up to date.—Lazarus Barlow, "The Times," Jan., 1914.

Radium, the cause and cure of cancer. Radium and radiation can produce cancer and probably can cure it. Report of 8 years' work.—L. Barlow, B.M.J. i./14,1001.

Middlesex Hospital Reports.—A large sarcomatous growth blocking up back of the nose and throat behind the soft palate causing loss of sense of smell, deafness and difficulty in breathing, apparently cured by **embedding** a platinum tube containing 82 mgr. of Radium in the tumour and leaving in position for 12 hours. A large abdominal sarcoma in a patient (a woman) was incised and 144 mgr. embedded for 24 hours. Reduction in size of tumour to half. Patient's weight increased. A third case reported is an epithelioma of the tongue, apparently cured after implanting 82 mgr. in the centre of it.—Daily Press.—Sept. 18, 1913.

A combined surgical procedure and implantation of platinum tubes containing Radium in an epithelioma in the neck with an extensive lymphatic infection of 15 months standing gave good result—tumour disappeared. Ten months after treatment further malignant processes were found, with renewed treatment as before—with success.—A. A. Warden, Paris, B.M.J. ii./13,1067.

Cancer of the prostate treated by introduction of the Radium tube into the urethra—or by this combined with another Radium Applicator into the rectum—thus producing a cross fire. Lengthy application and prolonged treatment required. A flexible elbow catheter of hard rubber is best used—with previous dilatation if necessary. It is claimed that the treatment permits of the reduction of an inoperable tumour so that prostatectomy can be under-

taken without danger. It will suppress hæmaturia and in certain cases may lead to a complete disappearance of the tumour and of the enlarged glands.—Pasteau and Degrais, 'Archives of the Roentgen Ray,' Apl., 1914

Dose and Duration of Irradiation.

A study of the foregoing abstracts shows that dose and length of treatment vary enormously with different workers—from a fraction of an hour to days. A careful examination of the data provided, the nature of the affection, and as far as possible experience with each case as it progresses will enable the practitioner to outline the treatment.

(III.) 'Spread Surface' Results (*Mainly*).

F. Soddy points out that by spreading a minute quantity of Radium over a large area, the thin film gives α rays essentially free from β and γ , since the two last from a small quantity are practically negligible.—"Interpretation of Radium."

In spite of this clear statement of the fact 'spread surface' irradiation has been much in vogue notably in France with long duration of treatment.

By using surface applicators and interposing screens it is possible to obtain action at a depth without altering superficial tissue. By this filtration one diminishes the sum total of the rays considerably, necessitating prolonged exposures—50 to 200 hours. The very penetrating rays (passing through a screen of lead and rubber 1.28 m.m. thick) are called in Paris the '**hard beta**' and the 'gamma rays,' the lead filter having absorbed the α , soft β , and 'medium' β rays

One may combine the bombardment (at a depth) by using 2 or more applicators around a tumour. This 'crossed fire' effect is very great, hence length of applying is reduced, and results in many cases are superior to those produced by γ rays. Various cases of carcinoma healed.—Wickham and Degrais, B.M.J. i./09,610,912.

All the α and most of the β rays absorbed by Lead Screens 1 m.m. thick. The remaining 'hard' rays, the γ and portion of the β almost as effective through 2 or 3 m.m. as through 1 m.m. These claimed to have the selective action on cancerous tissue. Ten or 20 sheets of paper with a further coating of indiarubber between the lead and the skin, employed to cut off secondary radiation which is stated to be irritant. '**Cross-fire**' method of intensifying results also referred to.—Wickham, L.i./09,1546,1557. See also B.M.J. i./09,242.

Sir Malcolm Morris mentioned tuberculous glands treated by Radium using 2 m.m. lead screen with long exposure,—2 hours a day for 6 days on one gland. Cured at end of three weeks and no sign of burning. Operable cases on mucous membranes better left to the surgeons. Results in such cases not so favourable as in superficial areas.

R. B. Wild said:—"The deeply penetrating γ rays after filtration, as indicated were hopeful for secondary gland lesions of cancer hitherto untreatable." Pharmacological experiments have been conducted by him on a frog's heart. Applying radiation from 16 mgr. pure Radium Bromide, it had no effect. The same applied to the skin in the same time would have caused a severe burn.

Screens of lead of various thicknesses used, e.g. screens of $1\frac{1}{4}$ m.m. thick of lead, covered with rubber allow only γ rays to pass.

Others of lead $\frac{1}{10}$ to $\frac{1}{2}$ m.m. thick permit the 'hard beta' rays as well as the gamma.—B.M.J. ii./09,445.

To keep out the α and the soft β rays which have a distinctive action on healthy and disease tissues and allow the γ rays, which have a selective action (and some of the hard Beta) to pass, it is customary to use 1 m.m. lead shields. If gamma rays actually have a more selective action than "X" rays Radium will have this marked advantage.—Jordan, L. ii./09,1742.

In the knowledge of the writers a case of sarcoma on the left side of the abdomen was markedly improved by the daily wearing of two circular aluminium faced Applicators measuring 3 inches in diameter,—the Radium being evenly spread (not varnished) in the Applicators. These were worn for over

two months with a lead screen in addition of 1 m.m. thickness and produced no burning whatever. Previously the case had been treated with a glass tube containing Radium, and burning had been produced which persisted for three months without healing. The case developed into keeping pace with the growth of the sarcoma by applying Radium; wherever there were no rays penetrating the growth spread.

The collodion or celluloid films used in France probably absorb the α rays. *Attempts to use the α rays from these films involve risk of loss of emanation and weakening of activity of the preparation, for no coating thin enough to allow α rays to penetrate is likely to be perfectly gas and water-tight.* To utilise the α radiation the layer must be spread out otherwise it will be absorbed within itself.—F. Soddy, B.M.J. i./09,797.

Radium Sulphate varnished on to pieces of linen in proportion of $2\frac{1}{2}$ mgr. per square Cm.—used with satisfaction in cancer. In the cases in point applicators of this kind,—one measuring $4\frac{1}{2}$ sq. cm., the other 9 sq. cm. were used. In one case the “hard nodular ulcerated surface below the tongue, extending from opposite the third left molar to the frenum, both sides being indurated,” was treated twice for one hour on consecutive days without lead screen and for 8 hours with a screen $1/10$ m.m. thick. Swollen adjacent glands were then treated for a prolonged period through lead varying from $1/10$ to 1 m.m. thick. In six weeks all glands had shrivelled to a size less than a pea, and after a second course could only be found with difficulty.

The ulcer had further treatment and was entirely healed. A slow growing carcinoma, with many relapses after operation, was kept in check for over 18 months. In the more chronic cases of cancer Radium may be expected to exert ameliorative effect. Another case of carcinoma of the breast had 500 hours treatment, including “cross fire,” without benefit. In deep seated growths the Radium must be put near the skin and the skin must be protected by 2 or 3 m.m. of lead, but in these no doubt burying the Radium in the tumour would be better. The response varies greatly,—in cases in which the Radium acts beneficially it acts at once.—B.M.J. i./11,429.

400 various cases, about $\frac{1}{2}$ of which were rodent ulcers, treated—the bulk of the work being done with 4 applicators, one containing 16 mgr. of Radium Sulphate on an applicator 1 inch square, another containing 6 mgr. on a circular disc $\frac{1}{2}$ inch in diameter and 2 small applicators of 1 sq. cm. area each containing 2.5 mgr. Long applications (3 to 4 hours) better than frequent short ones.—J. H. Sequeira, B.M.J. ii./11,895.

Sarcoma is invariably benefited, and if accessible and localised can be entirely removed. Rapidity of growth no contra-indication.—B.M.J. i./17,516.

Neoplasms of the skin, 61 cases, treated by Radium and “X” rays—a concise paper with useful data. Less than 1 hour doses of 5 mgr. per square centimetre unsatisfactory. In most superficial cases screening is not necessary.—A. A. Russell Green, L. i./17,544.

Tuberculous adenitis treated by Radium. Properly used a safe and certain cure. 15 mgr. spread on a flat circular applicator $1\frac{1}{4}$ in. in diam. is best. Screen of silver 1 mm. 10 hours is a suitable time for each application. Probably complete cure.—E. S. Molyneux, B.M.J. ii./19,705.

Cancer is being treated at Middlesex Hospital with large quantities of Radium at a time. It has been a matter of speculation whether clinical results of exposing a tumour to small quantities, say, $1/5$ th Gm. for a certain number of hours would be improved if the intensity were increased 25 times (i.e. 5 Gm.), the time being correspondingly reduced. Hitherto the difficulty has been to obtain a sufficiently

intense source of gamma radiation. This is now available.—L. i./20,164.

Cancerous ulcer at the inner angle of the eye treated with radium, weekly applications, also cancer of lip, penis and breast.—L. ii./20,152.

(IV.) Distance Filtration.

R. Abbe's 10 years' experience with Radium. 750 individual cases. 250 epitheliomata of all parts, including 180 carcinomata of the tongue, throat, œsophagus, uterus, etc. Lays great stress on "*distance filtration*" to ensure utilising γ radiation, *i.e.* by *separating* the radium $2\frac{1}{2}$ inches from the skin rather than metal screens. One can do in 2 hours what would occupy 40 hours by filtering through 20 m.m. of lead. Short applications in this way highly spoken of.—Abbe, B.M.J. ii./13,1915; L. ii./13,527.

Radium Institute Report for 1914.

The question of screens used as filters is exceptionally well dealt with in this article, and it must be consulted for the details. *Aluminium* screens are used with short exposures for capillary nævi, pruritus and other skin lesions. *Silver* 0.5 and 1 mm. for glass tubes introduced into tumours and in the treatment of keloid and vicious cicatrices. *Lead* for superficial epitheliomata, leucoplakia, fibromata and granulomata. *Platinum* for small powerful emanation tubes. Analysis of cases of carcinoma of breast and uterus.

Spring catarrh successfully treated. If carefully conducted granulations gradually disappear.—A. E. Hayward Pinch, L. i./15,454; B.M.J. i./15,367, 381.

Report for 1915-16.

A glance through the Report of the work from January 1/15 to December 31/16 is very instructive. Epitheliomata of the buccal, laryngeal and pharyngeal mucous membranes may give temporary improvement, but the final result is usually disappointing. Small emanation tubes of 50 mgr. or more initial activity screened with 1 mm. of Silver or 0.3 mm. of Platinum have been buried in the tissues for 18 to 24 hours with brisk reaction, and arrest of the disease. Carcinomata of the uterus are best treated by introducing a 50 mgr. or 100 mgr. tube screened with 2 mm. of Lead and 3 mm. of Rubber with external use of a flat applicator containing 80 or 100 mgr. on the abdominal wall.

The symptomatic improvement following the treatment of inoperable cancer of the uterus is most striking. In carcinoma of the rectum the best results were obtained in persons over 50.—Radium is not a substitute for operation in early cases of mammary cancer. For further review see B.M.J. i./17,515.

Report for 1917.

Analysis of cases of epitheliomata of the mouth, tongue, fauces and œsophagus, carcinoma of uterus, of rectum, of bladder and of the breast. Results in treatment of sarcoma on the whole more satisfactory than those of any other form of malignant disease except rodent ulcer. Radium rays though affecting normal tissues to a much less extent than morbid tissues, do affect them—this is a hindrance to an unlimited increase in the amount of radiation employed. Rodent ulcer most gratifying. Use of Radium to check menorrhagia and metrorrhagia accompanying fibroid disease of the uterus. Exophthalmic goitre at first aggravated, but later all the symptoms ameliorated (6 to 8 weeks).—B.M.J. i./18,349. L. i./18,442.

Manchester and District Radium Institute Report. All early rodent ulcers can be cured.—B.M.J. i./19,320. P.J. ii./16,530.

Radium Applicators.

Insoluble Salts of Radium, *e.g.* Sulphate and Carbonate, can be even spread using special varnishes for 'surface' action. In addition the following are suggested:—

Metal tube-form Applicators in aluminium, platinum, gold, silver, lead, etc. These are usually about 3.5 Cm. long by 1 Cm., to 2 mm. thick in the wall, enclosing a sealed glass tube containing 10, 20 or more mgr. of Radium Bromide, and are suitable for general use where strong action at a superficial point is required, or for sinking into cavities, *e.g.*, sinuses or for throat work. A small chain or flexible wire may be attached for safety. In these there is absolutely no fear of loss of emanation.

Minute Metal Applicators may also be made, *e.g.*, 1.5 Cm. long by 3 m.m. external diameter, so as to be completely filled by the Radium *without any glass lining*. For throat work a movable gag may be arranged on the flexible wire for the patient to hold between his teeth.

The small applicators with a chain are suitable for *urethral* use. They may be used in a rubber catheter. They are also suitable for use in the œsophagus and uterus.

Suppository shaped Applicators are made for use in rectal cases; for such, however, one of the minute Applicators may be preferable, *i.e.*, where there is enlargement of the tissues.

Aluminium (Surface) Applicators.

These are circular in shape with a perfectly flat surface. They may be made of any diameter, *e.g.*, $\frac{1}{2}$ inch up to 4 or 5 inches or more. The powdered Radium is spread immediately beneath the aluminium window.

Lead screens of various thicknesses may be used. This form of Applicator may be curved to fit the surface requiring treatment.

Glazed Applicators containing Radium Sulphate are made. In these the Radium is distributed throughout the glaze layer which is 0.3 mm. thick and fused on to the silver back. "Full strength" is the name given to those having 5 mgr. per square centimetre. Other strengths are made.—B.M.J. ii./17,556.

A word in conclusion as to Applicators. The effect produced by a sealed glass tube containing the Bromide (the most accessible salt commercially) on a platino-cyanide screen held a little distance away is very striking in its even distribution. A tube so arranged will produce an excellent even action on the part to be treated, and has obvious advantages. Suitable screens can be added as desired.

Radium Emanation in sealed glass tubes from 400 mgr. of Radium Bromide in solution has been introduced into the interior of the body,—mouth, throat, œsophagus, rectum, uterus, &c., where "X" rays cannot well be used. Such sealed tubes behave physically like similar tubes of Radium Bromide crystals. The radiations are the same, but their radio-activity falls to half value in 3.7 days. With the above stock solution it is possible to withdraw the equivalent of about 40 mgr. of Emanation daily without diminishing value of the stock solution (which regains activity). The glass tubes are then enclosed in 1 m.m. thick lead tubes, and these again in rubber and are suitable for insertion into the rectum or cervix uteri in re-

current or inoperable carcinoma. May be enclosed also in rectum or stomach tubes. "X" ray examination will show whether the tube lies at the right spot. Results have been promising.

Sir Wm. Ramsay's apparatus for collecting Niton from Radium Bromide and its use in tubes, bulbs, etc.—L. i./14,1481.

Suggestion to employ *a* radiation obtained by exposing needles (negatively charged) to the emanation, by which a large quantity of active deposit is concentrated on same. Such needles to be inserted into growths. The $\frac{1}{2}$ value (*c.f. antea*) of same would be 20 minutes.—Jordan, L. ii./09,1742

Emanation in skin affections :—

Eczema of the fingers cured by a solution of Radium Emanation in weak gelatin. Applied with a covering of muslin and then with lead foil which was bandaged on. (Prolonged applications,—12 hours desirable.)

Granulomatous tumours well treated by weekly injection of Radium Emanation in 2 Cc. of water. This would be employing all three types of radiation.

Psoriasis patches on the knees completely removed by the gelatin solution. Mycosis fungoides benefited by the Radium gelatin solution.—L. ii./09,1446

Emanation Tubes inserted into growths.

In a case of inoperable parotid tumour and scar fixing wrist. Economical and safe in use.—B.M.J. ii./14,9.

Cancer, recurrent of the vulva, an apparently hopeless case *cured* by a radium emanation tube covered with gauze, inserted into the vagina and left there 24 hours.—Sir T. Oliver, L. i./15,272.

Painful and adherent scars from war wounds well treated by the hard beta- and gamma- rays from Radium 'C' employing emanation tubes.—W. S. Stevenson, L. i./18,432.

The size of Emanation tubes for insertion into growths has been reduced as methods improve. It is possible to charge with Emanation capillary tubes which fit into platinum needles of a total length of 14 mm. diameter, 1.7 mm., and thickness 0.3 mm. The glass capillary tube fitting such a screen has a capacity of about 3.5 cubic millimetres and can be made to contain Emanation equal in activity to 50 mgr. of Radium Bromide.—W. L. S. Alton, Radium Institute Report, closing December 1916.

Radium Emanation is a much more convenient source of Radium 'B' and 'C' than solid Radium salt—the therapeutic agents of which are the penetrating beta and gamma radiation given off by these two products. Emanation confined in a receptacle increases in activity for the first four hours—*i.e.* until Radium 'C' equilibrium is established. Capillary tubes filled with emanation contained in Serum Needles can be inserted into tumours. Twenty-eight patients with inoperable malignant disease treated by this means. Much greater uniformity of radiation is possible.—W. C. Stevenson, B.M.J. i./15,498.

Effects of emanation tubes in ulcerating epithelioma of the month and other cases.—W. G. Harvey, B.M.J. i./15,893.

In treatment of cancer by burying Radium Tubes and Emanation tubes it is better to get even distribution by using a number of weaker tubes accurately implaced than to push tubes especially strong ones blindly into a tumour. Manchester experience.—L. i./16,308; B.M.J. i./16,247.

Radium and its Therapies. A general complete and temperate review of the subject. Radium Emanation water as made by the Radium Institute containing 1 to 2 millicuries per litre had been found of great value in arthritis deformans.—J. Macdonald Brown, P.J. i./16,269.

Wertheim's hysterectomy for advanced carcinoma of the cervix made possible by the use of Radium Emanation tubes buried in the cervix and surrounding tissues. The action of radium in growths of this type is wonderful.—L. i./20,1270,1278.

Petroleum Solution has been suggested as a better solvent for the emanation both for internal use and injection into tissues.

Respiratory diseases in future may be dealt with as the emanation is rapidly eliminated by the lungs.—B.M.J. i./13,1196.

Agar Plates.—A piece of lint about the size of a 5s. piece is dipped in Agar-Agar Solution and exposed in an electrified condition. The emanation

clings to the surface. The method is looked upon as promising one of the most useful applications of Radium for superficial cases. The particles are then ionised into the deeper structures by galvanic current. In use at the Cancer Hospital, Fulham.—B.M.J. i./13,1196; C.D., Dec. 7/12.

Radium Emanation Water.—*Dose.*—Half a pint a day six days a week for six weeks for patients suffering from rheumatic gout and similar affections. Two such courses generally effect a cure. This refers to the Radium Institute product which is stated to be 4000 to 5000 times stronger than Spa Waters.—Sir F. Treves, P.J. ii./13,547.

The radio-active matter is eliminated chiefly by the lungs. In gout and rheumatism the emanation keeps Uric Acid more soluble and purifies the blood.—Armstrong.—B.M.J. i./11,992.

Roskrow Natural Water (Radio-active).

Dose.— $\frac{1}{2}$ a tumbler twice or thrice daily increased, with or after food.

This Cornish water is chemically of exceptional purity. Its content of organic matter is *nil*. The total inorganic Solids are only 16 parts per 100,000. (L. Aug. 21/14, found 15.2 parts).

The Radium Content of the water is 3.6 mgr. per 10^6 litres.

Radium Emanation (in equilibrium with the above) = 0.036 microcuries per 10 litres.

The amount of radio-activity exceeds that of any other natural British Radio-active Water. The radio-activity of the Water is permanent. In the case of artificial Radium Emanation Waters the radio-activity lasts only for a few days.

The non-mineralised condition of Roskrow Natural Water places it in line with the waters of Buxton and Vichy which rely for their therapeutic effect on their exceptional purity.

Uses.—The exact effect of drinking and inhaling radio-active substances is not definitely understood, but numerous clinical investigations have shown that there is beneficial effect on metabolism. In particular is this the case in the matter of Sodium Biurate in rheumatism (formation of Soluble Ammonium Salts—easily eliminated.—Pres., Jan., 1913); hence the Water is suggested for use in gout, rheumatic affections, neuritis, arterio-sclerosis, and in all cases where the consumption of a relatively non-mineralised natural water is indicated.

Actinium Emanation is many thousand times stronger than Radium Emanation owing to its rapid period of decay (4 seconds) hence should be more suitable for treatment by inhalation.—Glew, P.J. i./11,339.

Inhalation and Subcutaneous Injection of Radio-active Oxygen in cases of obstruction in the air passages, i.e., in membranous croup, diphtheria, œdema, and other affections which interfere with the proper aeration of the blood, especially useful. In the anæmia of tuberculosis and phthisical cough where a rapid modification of symptoms occurs in dyspnoea, insomnia, hæmoptysis, night sweats, and fever, sometimes even in cases of advanced cavity formation.

The apparatus is simple, consisting of 2 and 1 litre 3-necked Woulf's bottles, a cylinder of oxygen and a spray bellows.—N. L. Usher-Somers. For method of working, see Med. Times, May 31/13.

Sea Water contains about 0.9×10^{-12} Gm. Radium per litre, i.e. 1 billionth part of a gramme per litre in the North Atlantic; various

other sources yielded an average of 16×10^{-12} Gm. per litre,—the amount in River waters is less—*e.g.*, about $\frac{1}{4}$ that of the Atlantic for the St. Lawrence, and the Nile respectively. The amount in The Atlantic is said to be about $\frac{1}{20}$ that in a *weak* radio-active spring. These measurements were *not due to Radium Emanation dissolved*,—the waters being in some cases several months old,—but proved the presence of both emanation and the parent Radium, hence the amount of emanation in a sample of sea water *remains constant*,—its spontaneous disappearance is balanced by its production from the parent substance.—S. Russ.—L. ii./11,851.

The Sea contains about 20,000 tons of Radium. One ton of Radium is equal to 1,500,000 tons of coal in energy. A Gm. of Radium gives off in its lifetime about 3,000 horse power.—C. E. S. Philips, Cancer Hospital Lecture, 10/12/13.

See also **Sea Water Injections**.

Pitchblende Ointment.

Pitchblende 25% finely powdered in Soft Paraffin. In the palliative treatment of malignant growths.

Radium Ointment, Radium Salve.—Preparations under these names have been supplied commercially—*see* Patent Medicines. There is good reason to believe that weak Radium Ointments, preferably made with a thoroughly dried soft paraffin basis, might prove of considerable utility in some cutaneous affections, *e.g.*, in lupus, psoriasis, eczema, boils, ulcers, and ringworm.

Radio-active Mud.

Continental Spas with a reputation for treatment of rheumatic affections by mud baths owe their results probably to the fact that the mud is radio-active. Such mud can only be used at the source.

Uranium Mud or Actiniferous Earth is similar, it is understood to be the by-product formed during the process of breaking up uranium ores. Its radio-activity is said to be due to traces of Radium, Polonium, and in particular to Actinium. It emits emanation of low activity in comparison with Radium.

Rheumatic arthritis, gonococcal rheumatism, nerve affections and skin diseases have been treated by compresses and pads of the mud, or in baths, about 8 ounces to 40 gallons of warm water. The length of application of pads varies with the case—it may be several hours.

Radium Ionisation.—*see* Iontophoresis.

Ova of *Ascaris Megalocephala* are affected by Radium,—firstly cell division is more rapid, secondly, antagonistic action. Animal extracts had similar effect. Formalin vapour produces also acceleration in early stages.—L. Barlow, B.M.J. ii./10,533.

RADIO-ACTIVITY OF OTHER ELEMENTS.

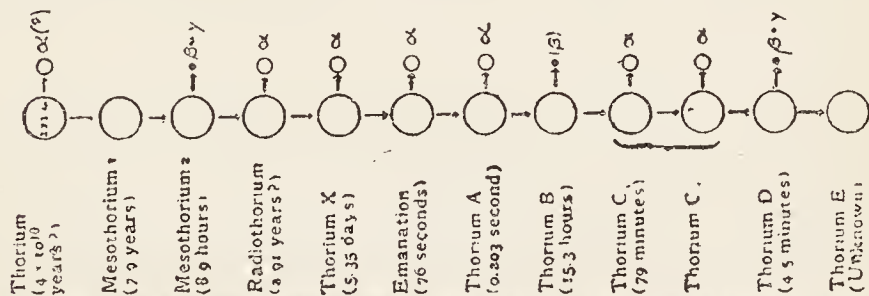
In addition to the known radio-active bodies, Rubidium Compounds, *e.g.*, Rb_2SO_4 Potassium, Beryllium and Lanthanum (? due to Thorium) are radio-active. The plates used in the experiments were covered with black paper so only β and γ rays could affect them. Almost all the other elements in Mendeléeff's Table (Groups I. to VIII.) are *not* radio-active.—J.R.S., Jan., 1910, p. 29.

Thorium changes, broadly speaking, into Meso-Thorium, and this to Radio-Thorium, and this to Thorium X, and this to a series of other products. The following data are generally given:—

Half-Value (*c.f.* Radium chapter) of each Disintegration Product.

Thorium emits α rays	5.5 years
Meso-Thorium emits fairly penetrating β (and γ) rays ..	2 years.
Radio-Thorium emits α rays	3.6 days.
Thorium X emits α rays	

The following table from Prof. Soddy's "Interpretation of Radium," gives a graphic representation of changes which occur, together with the Average Lives. (Note $\frac{1}{2}$ value $\times 1.45$ = Average Life approx.).



That of Radium is somewhat less than formerly accepted. The most accurate recent figure is 1.905 years or 696 days for the half value or 2.75 years for the average life.

For the period of Mesothorium-I a value was found, namely, 6.7 years, much higher than that (5.5 years) usually accepted for the half period. The new average life would be 9.67 years.

For the period of Thorium a new figure for the half-period, namely, 2.37×10^{10} years, assuming that of Radium to be 1740 years, as compared with previous values ranging from 1.28 to 1.86 (10^{10} years).—*Abst. Ann. Rep. Chem. Soc.* 1919 (Vol. XV.), p. 220.

Thorium shows an activity, measured by α rays, about the same as pure Uranium compounds, but the β and γ ray activity is feebler.

Prof. Soddy states that in the by-products of a single year's manufacture of Thorium for the mantle industry the Mesothorium and Radio-Thorium capable of being extracted possess as much radio-activity as at least an ounce of pure Radium.

The disintegration through eleven members as indicated in the above graphic table has close analogy with the eleven members seen in the Uranium series as far as Radium D.

In the case of Radio-Thorium, this body corresponds exactly with Ionium in the Uranium series. They are chemically identical with one another and with Thorium itself and cannot be separated when mixed together. This is important as Thorium when separated from a mineral always contains at first all the Radio-Thorium in the mineral and also all the *Ionium* if Uranium was also present, as is almost invariably the case. Thorium X is chemically identical with Radium and also with Mesothorium 1.—“Interpretation of Radium.”

Thorium 'X' is prepared from pure Thorium Salts (which always contain Radio-Thorium, the immediate parent, in considerable amount). It is obtained by addition of Ammonia to a Solution of a Thorium Salt, and evaporating the filtrate and removal by ignition of the Ammonium Salts. It is transformed directly into emanation so that the rate of production of emanation is directly proportional to the amount of Thorium 'X.' About a month after removal of Thorium 'X' the Thorium regains its original activity and shows an α ray activity equal to about one-quarter of its value before separation. This was at first thought to be the activity due to Thorium itself, but later work has shown that this residual activity is due in part to unseparated products. After separating the thorium from the Ceylon mineral Thorianite which yields large quantities of helium, Hahn found a radio-active substance of slow rate of transformation in the residues which gave rise to Thorium X, and the Thorium emanation.—Radio-Thorium.

Radio-thorium, as already stated, is not separable from Thorium by any chemical process. Hahn, in an investigation of Monazite Sand residues to obtain Radio-Thorium if possible on a larger scale, found that other radio-active products must be present in thorium. On examining commercial preparations of Thorium of known ages, it was found that the α ray activity of Thorium after separation decreased at first for some years, passed through a minimum, and then slowly increased again to a final value represented by the activity of a pure Thorium compound, from which none of the radio-active constituents had been separated. To explain these results, it was necessary to assume the existence of another product in Thorium called **Meso-thorium** which had been produced from Thorium and was transformed into Radio-Thorium. The half value period of this substance was found to be about five-and-a-half years.

Meso-thorium is chemically very similar to Thorium X and to Radium. Boltwood found that the activity of a preparation of Thorium X, obtained in the ordinary manner (*vide antea*) decayed for about a month, passed through a minimum, and then steadily rose again for several years. This rise of activity has nothing to do with the Thorium X, but is a consequence of the *separation of the meso-thorium with the Thorium X. Meso-thorium does not itself emit α rays; but is slowly transformed into the radio-thorium and later products, which do.* The rise of activity observed is to be thus ascribed to the α ray activity of these later products.

Meso-thorium was at first believed to emit β rays, but later work has shown that this is due to the presence of a substance of quick period, which is produced by the meso-thorium. This new product called meso-thorium 2 emits only β rays, and has a half value period of 6.2 hours. One day after separation from meso-thorium, this new product is nearly in equilibrium with its parent substance, and for practical purposes, it suffices to include the two products under the title meso-thorium.

Meso-Thorium is easily separated from Thorium. There is no doubt that the initial discovery of Radio-Thorium in the Thorium residues was not a result of the separation of Radio-Thorium directly from the Thorium, but of the separation of Radio-Thorium

which had grown in the interval from Meso-Thorium. A day after separation a preparation of Meso-Thorium shows a strong β and γ ray activity.

The paper by Sir E. Rutherford from which we are quoting then deals with the variations in activity of the preparations of Meso-Thorium with time.

“ Since meso-thorium loses half its activity in 5.5 years, the amount of meso-thorium will decrease exponentially with the time with the same period ; one quarter of the meso-thorium will remain after eleven years. The meso-thorium, however, immediately commences to produce radio-thorium, and the latter thorium X, the emanation, and the active deposit in successive stages. The variation in the amount of radio-thorium present can readily be calculated. The amount increases rapidly for several years, reaches a maximum in 4.6 years, and then diminishes, finally decaying exponentially with the period of meso-thorium, *i.e.*, half value in 5.5 years. Curves showing the decay of meso-thorium and radio-thorium and the variation of the amount of radio-thorium with time in a preparation of pure meso-thorium, are provided in the communication, as also a table showing the disintegration of the thorium series*. The α ray activity due to the production of radio-thorium and its products will consequently reach a maximum in 4.6 years from the beginning. In a similar way, the rate of production of emanation reaches a maximum at the same time. Since the active deposit of thorium emits γ rays, the γ ray activity due to a preparation of meso-thorium at first increases with the time. The exact relation between the intensity of the β and γ rays of meso-thorium and the active deposit is not accurately known ; but there seems to be no doubt that the β and γ ray activity of the preparation will increase for about three years, pass through a maximum, and then finally decay with the period of meso-thorium. At the maximum, the activity is about 1.5 times greater than the initial value.

Sir E. Rutherford states that as a large amount of Thorium is being continually separated for the mantle industry the activity of the Meso-Thorium capable of separation is very great, and there seems to be no reason why an amount of Meso-Thorium equivalent in β and γ ray activity to several grams of radium should not be produced annually.

Commercial Meso-Thorium is standardised by comparing the γ ray activity with that of a standard Radium preparation.

A, β and γ ray activity in a specimen of Meso-Thorium initially equal to one milligram of radium will increase in three years to the equivalent of 1.5 milligrams, and after ten years will again be equal to one milligram. Consequently during this ten years it has an average activity equal to 1.2 milligrams of Radium. It will ultimately decay to about half the initial value after twenty years.

“ On certain assumptions, the rate of transformation of thorium itself can be calculated. The rate of transformation is slower than that of uranium, and half the thorium should be transformed in an interval of 15,000 million years. Since thorium in disintegrating emits a helium atom, the atomic weight of meso-thorium and also of radio-thorium should be about 4 units less than that of thorium, *i.e.*, 228.5. It can be calculated that a pure preparation of meso-thorium, one day after separation, should show a β and γ ray-activity at least 100 times greater than that of pure radium one month old ; while one month after separation the α ray activity of pure radio-thorium and its product should be about 300 times greater than that of radium in equilibrium. It thus seems probable that ultimately preparations of meso-thorium should be obtain-

*The Table in question is similar to that which we reproduce from F. Soddy's ' Interpretation of Radium, 1912,' excepting that in the former ' Half periods are given, whilst in the latter are ' Average Lives.' Note, however, that the two equivalents are not interchangeable throughout in the respective tables by the customary formula ($1/\lambda = 1.443 T$ or Average Life = $1.443 \times$ Half-Period).

able in which the activity is far more concentrated than in the case of radium."—From a lecture by Sir E. Rutherford, before the Rontgen Society, Jan. 5, 1911. J.R.S., April, 1911.

In amplification of the above, the following, which is based on a paper by Sir E. Rutherford may be quoted. One must understand that there is a large number of products and descendants from Thorium to some extent analogous with those from Radium. The emanation diffuses from a Thorium compound. Thorium Hydroxide emanates freely, as also the Oxide, but the Nitrate gives off very little, disappears at a definite rate,—half breaking up in 54 seconds, one half of the remainder in the next 54 seconds and so on. There is a deposit formed by the emanation which breaks up successively into Thorium A, B, C and D, all differing in chemical composition. With each break up an α particle (an atom of Helium) is emitted. Thorium A has a half value of 10.6 hours. *Thorium X, may be called an intermediate stage between Radio-Thorium and Emanation. The important points regarding it are given in the previous abstract of Rutherford's communication. **Radio-Thorium** is the immediate antecedent of Thorium X. Although initially Meso-Thorium has no α ray activity it "grows" Radio-Thorium in a few years,—which ultimately changes into Thorium X and Thorium X into Emanation. The maximum amount of Radio Thorium that will grow from a quantity of Meso-Thorium is reached in 4.6 years. The activity of a preparation of Meso-Thorium thus rises for about $3\frac{1}{2}$ years, when it would be upwards of twice as great as initially,—it would then die away. For *medical purposes* Meso-Thorium is said to be as good as Radium,—its β rays are equally penetrating, and its γ radiation slightly more so.—B.M.J. i./11,102

See also F. Soddy on Meso-Thorium J.C.S.T. '10,72

W. Markwald, writing on Mesothorium says :—Mesothorium can be separated from the residues of the thorium manufacture by using the methods employed in separating radium from uraninite residues :—

Meso-thorium preparations obtained from monazite must contain radium owing to the presence of uranium in them, since no method of separating these two substances is known. Moreover, the radium obtained from thorium ores rich in uranium as, for example, thorianite always contains meso-thorium.

As the duration of life of radium is about 300 times that of meso-thorium it is very important when studying a "radium preparation" to take into account the possibility of its containing meso-thorium. There is also the danger of deliberate adulteration. The simplest way to test a radium preparation for meso-thorium is to heat it for a short time to drive off the emanation. The preparation must then lose its γ -radiating power after a few hours, completely regaining it only after the lapse of many weeks. Instead of heating it, it can of course be dissolved in water and the solution evaporated. If after the radium emanation has been driven off, and the radium C has been destroyed (which takes a few hours) there is still some γ -radiation, this is due to meso-thorium. The ratio of the γ -radiation before and after the treatment is a measure of the proportion of radium and meso-thorium in a mixture.—*Berichte* xliii., 3240. Chemical News, Jan. 13, 1911. J.R.S., April, 1911. J.C.S.A. ii./11,8.

Professor Soddy points out that the chemical similarity of Radium and Mesothorium forms an example of two elements of entirely

* Here the table will be seen to vary in accord with more recent discoveries.—*c.f.*, Rutherford and Geiger. Phil. Mag., 1911 (vi.) 22,621 and F. Soddy's "Interpretation of Radium."

different radioactivity but **entirely identical** chemical character. This being so, the **process of extraction** of Mesothorium from Monazite residue is entirely similar in principle to that of Radium from Pitch-blende residues.

This physicist patented a method of separation of Meso-Thorium from a mixture even as complex and poor in Meso-Thorium as Monazite sand. It consists in using his discovery that the action of Barium in the separation of Meso-Thorium is not a physical one confined to Barium Sulphate, but is due to an almost *complete chemical similarity between Meso-Thorium and Barium*.—P.J. ii./11,508.

Meso-Thorium and Radio-Thorium produce very marked effects on a Zinc Sulphide Screen.

Ratio of Mesothorium to Thorium.—H. N. McCoy & L. M. Henderson (Abst.), J. R. S., Apl. '19, p. 62.

Therapeutic Use of Thorium Degradation Products.

Sir E. Rutherford states Thorium Salts are poisonous if introduced in the system.

I. Meso-Thorium. Action on malignant growths is said to be 'just like Radium.' Cases of cancer of the tongue showed improvement. Psoriasis plaques have been cured after 'X' rays failed.—See also L. i./14,418.

Biological Action of Thorium.—P.J. ii./11,881.

V. Czerny and A. Caan believe Radium to be inferior to Meso-Thorium in treatment of superficial tumours, angiomas, lupus and keloid scars.

Meso-Thorium burns from lengthy application (3 to 24 hours) of 20 to 60 mgr. in silver tubes, 0.06 m.m. thick, introduced into the posterior vaginal fornix or into the canal of the cervix. Some patients with cancer of the cervix tolerated for much longer without ill effect.—B.M.J. ii./13,828.

Malignant and non-malignant cases treated by introduction of Meso-Thorium into the uterus in capsules.—B.M.J. ii./13,923.

Myomata and other uterine diseases enthusiastically reported on. The special filter for the Meso-Thorium which removes the α and β and leaves only γ rays consists of 2 m.m. of lead, $\frac{3}{4}$ m.m. of gold and $\frac{1}{2}$ m.m. of Platinum. So filtered said to have curative action on cancer even in the deeper layers, though there is no effect on metastasis.—B.M.J. ii./13,45; L. ii./13,1787.

Chronic deafness treated with and improved by Radium and Meso-thorium irradiation.—H. D. McCulloch, L. ii./13,223, 1093.

II. Thorium 'X.'

Thorium 'X' has been injected into sarcomata and given intravenously in dose (?) of 1/100,000 mgr. in 1 Cc. of Normal Saline, but is dangerous and must be used with caution.

Thorium 'X' Poisoning

A woman, age 58 with chronic arthritis, injected with a dose of Thorium 'X' Solution representing 900,000 Mache Units, complained of pain in hands. Nine days later 550,000 Mache Units were injected with no definite improvement. Then 10,000 M.U. of Thorium 'A' were injected, the result being so unsatisfactory, that a fourth injection of 3,000,000 M.U. Thorium 'X' was given. After three days diarrhœa, weakness and pains in abdomen

developed with vomiting of blood, seven days later patient died. It would appear that Thorium 'X' in full dose had given rise to an illness characterised by acute hæmorrhages from mucous surfaces—the onset being late (as shown by experiments on dogs).—Gudzent, Berl. Klin. Woch. May 13, 1912, per B.M.J. ii./12,136.

Leukæmia treated at Erlangen.—300 to 400 Electrostatic Units (1 E.U. = 1000 Mache—*c.f.* Radium) the highest dose being 1000 E.U. In pernicious anæmia 10 to 70 E.U. In rheumatic and joint affections best results amongst various diseases treated. Small doses at first increased to maximum of 500 E.U. or continued for a considerable time. Given both *per os* and intramuscularly. The treatment strongly advised.—B.M.J. ii./13,1107. See also B.M.J.E. ii./13,87.

ANTISEPTIC POWER OF NUMEROUS CHEMICALS AND DISINFECTANT PREPARATIONS FOR SURGEONS' USE.

We have for some years been engaged in practically determining the Antiseptic Powers of General Chemicals as well as Proprietary Disinfectants and herein we bring our knowledge of the subject up to date.

Of the various methods of assaying the value of a disinfectant the '**Lancet**' Method—a modification of the Rideal-Walker method—is undoubtedly the easiest to conduct and it gives satisfactory valuation.

From the historical standpoint it will be well to briefly describe the original Rideal-Walker Method:—

Rideal and Walker advocated comparison of germicidal value of different disinfectants with Carbolic Acid (*c.f.* B.M.J. i./07,841).

To Conduct a Rideal-Walker determination we operate as follows:

First prepare a standard dilution of Phenol which will kill the test organism (*B. Typhosus*) in between $2\frac{1}{2}$ and 15 minutes, *e.g.* strength 1 in 120. The test consists in determining the dilution of the Disinfectant under examination that will kill the organism in the same time as the Phenol Dilution. One prepares a range of dilutions of the Disinfectant with sterile distilled water which will in all probability include the lethal strength, *e.g.*, in a case in point 1 in 720, 1 in 960, 1 in 1200 and 1 in 1440. 5 Cc. of each of these are placed in a test tube rack alongside 5 Cc. of a 1 in 120 Phenol Solution. 5 drops of a 24 hours' broth growth of *B. Typhosus* are added to each tube from a pipette. Behind these 5 tubes one has 6 more racks each containing series of 5 tubes. At intervals of 30 seconds one removes with a standard platinum loop, 3 mm. in diameter, loopfuls (Rideal says "five") from the front row and adds them to the tubes immediately behind. The row behind this inoculated one is then inoculated in the same way from the front row, and so on from the original until all six racks have been treated under identical conditions with exception of the time. One then incubates for 72 hours and observes the dilution, *e.g.*, 1 in 1200 in the case in point which kills the organisms (determined by the fact of opalescence of the dilution next in order) in the same time as the Phenol dilution. The R.W. Coefficient is then $\frac{1}{2}\% = 10$. It is, of course, necessary to conduct controls throughout—broth tubes both inoculated and not inoculated.—*c.f.*, R. T. Hewlett, L. i./00,819.

The Rideal-Walker method has been largely used by the War Office.—B.M.J. i./19,359. This method of testing is not approved or otherwise by the British Disinfectants Manufacturers' Association. Where this method of testing is called for a standard technique will be adopted.—W. N. Drew, *ibid.* 429.

The figure for a disinfectant varies for different organisms; also certain organisms, *e.g.* *B. Anthracis* and *B. Typhosus*, show a variable resistance to a disinfectant.

Our early work (started in 1908) was conducted with a *variety* of organisms (*B. Typhosus*, *Staphylococcus*, *B. Anthracis*, etc.), but it is obvious that only by using what may be termed a Standard Type of Organism, namely, *B. Coli*, and using identical conditions, can comparative results be arrived at. For general purposes this organism is undoubtedly the best, and we now adopt it to the exclusion of the other bacteria. In some cases notes on results with other organisms are added or retained where of interest.

We have found that some substances, e.g., *Saccharin Insolubile* acts as a germicide on *B. Coli* but not as a fungicide.

The suggestion has been made to alter the Ridcal-Walker Coefficient Method of examining Disinfectants by introducing organic matter—milk, urine, fæces etc.—into the disinfectants, as it is claimed that the real test of a disinfectant is the strength and time of exposure which will enable it to kill organisms in the presence of such, but the idea has met with disfavour; and here again we fail to see how any uniform simple standardisation can be introduced with the interference of such substances.

STANDARDISATION IN PRESENCE OF FÆCES.—There is no doubt that if faecal matter be introduced as a normal standard many reputed disinfectants must lose much of their reputation.—B.M.J. i./09, 286, 296.

The **Garnet Method** of conducting the test is described.—B.M.J. ii./09, 213
L.C.C. Report on Disinfectants:—Phenol Solution 1 in 20 and Mercuric Chloride 1 in 1,000 are true germicides for *B. tuberculosis*.

Standardisation of Disinfectants.

Prof. Delépine emphasized the importance of distinguishing the mere inhibitory or antiseptic action from the germicidal power. His experiments show that the first product of action of Mercuric Chloride on bacteria (? Albuminate of Mercury) remains when sufficiently diluted in such a way as to prevent growth, but when the Mercury is removed, as by Ammonium Sulphide, the bacteria resume activity. Hence in all testing of disinfectants the actual death of the organisms should be ensured.

Reports on disinfectants which combine with protein or other matter or which oxidise it, must be regarded with caution when investigations have been conducted on bacteria in the absence of such organic matter (Phenols and Phenoloids are little affected by organic material of this kind). It is important to realise that the action of disinfectants is affected by protein substances, fats, urea, uric acid, organic and inorganic salts, alkalis, acids, masses of non-pathogenic bacteria, cells, etc., all of which are present in morbid products, hence it is not surprising that Prof. Delépine does not attempt to lay down conditions for tests—he regards the knowledge of the action of disinfectants as too ‘empirical.’—B.M.J. i./11, 157.

Emery's Standard Method.—Citrate Blood used as diluent with *S. faecalis* (the enterococcus) as organism. Amongst results it is shown that Carbolic Acid is about 70 times as strong as Eusol and Dakin's Solution. Malachite Green is the most potent of the antiseptics examined. Iodine 1 in 300 to 400 is quite inert to “sterilise” a wound.—W. D'Este Emery, L. i./16, 817.

There is obvious need of an **International Standard Method** with clearly defined rules for procedure. As things stand at present, some work with one test organism, others work with another. Different times of contact are used. Some insist that

the presence of blood serum is essential ; others require the presence of faecal matter, and so on to infinity.

In the interests of humanity and honest trading, it is clearly essential that official control should be exercised over proprietary antiseptics, and that their potency should be stated on the labels according to an official standard method.—W. H. M., Medical Press. c.f. S. Rideal, L. ii./13,826.

The "Lancet" Carbolic Acid Coefficient. The figure representing the percentage strength of the weakest lethal dilution of the Carbolic Acid control, using *B. Coli* as test organism, was divided by the figure representing the percentage strength of the weakest lethal dilution of the disinfectant being tested. This was done at $2\frac{1}{2}$ and at 30 minutes and a mean of the resulting figures was taken as the Carbolic Acid Coefficient.

The Bacteriological and Chemical results included the following :—

COAL TAR DISINFECTANTS FORMING EMULSIONS WITH WATER.—

	Co- effi- cients.	Phenols or Pheno- loids.		Co- effi- cients.	Phenols or Pheno- loids.
Cofectant ..	9.8	66.27	Pearson's Anti-		
Sanitas Bactox	9.5	39.7	septic Fluid .	2.2	20.7
„ Okol ..	8.9	48.5	Jeyes'		
Cyllin ('bulk')	8.8	40.41	(Chemists')	1.7	17.8
McDougall's			Lawes'	1.6	28.2
MOH Fluid..	7.9	47.13	Zotal ..	1.5	10.0
Kerol ..	7.7	40.56	Krysyl..	1.3	14.16
Izal ..	7.4	41.35	Jeyes' No. 2		
Cyllin			(Grocer's) ..	0.75	5.13
Medical ..	6.4	32.08			

CLEAR WITH WATER.—

	Co- efficients.	Phenols or Phenoloids.		Co- efficients.	Phenols or Phenoloids.
Crude Carbolic			Calvert's No. 5		
Acid.. ..	4.2	82.65	Carbolic Acid	2.5	93.26
Trikresol ..	2.5	—	Lysol ..	1.7	50.96

L. ii./09, 1516.

It should be noted however that the figures for Phenols or Phenoloids were obtained by simple extraction with a solvent, the Phenol content indicated by *Bromine*—the more scientific method—was considerably less (about $\frac{1}{2}$ in many cases).

The Lancet Coefficient compares % dilutions whilst the Rideal-Walker Coefficient compares the figures representing the dilutions as compared with unity—inversely.

Sanitas Okol and Sanitas Bactox, it is contended, were examined in an old and superseded style. Sanitas Fluid should not have been classed among tar disinfectants. This was an acknowledged slip on the part of the Lancet Commission.

Full description of Sanitas,—not intended as a powerful germicide.—L. ii./09, 1850.

Jeyes' Managing Director, Ainslie Walker, intimated that Jeyes' Fluid had a Rideal-Walker Coefficient ranging from 5 to 22 according to purpose required,—e.g., the brands Crude Cyllin and Special Fluid Cyllin.

Following on the "Lancet" Commission Report a most animated discussion on the subject took place at the Cambridge Meeting 1910, of the British Pharmaceutical Conference at which Sims Woodhead and C. Ponder (Members of the Commission) read a paper on Bacteriological Standardisation of Disinfectants. They drew attention especially to the following:—

B. Coli Communis as test organism, though slightly more resistant than *B. typhosus*, has the advantage of being non-pathogenic and readily recognised with great certainty by the use of McConkey's Bile-Salt Litmus Medium, *q.v.*, without the use of the microscope (change of the litmus colour by acid production). From the medical man's point of view a virulent *Staphylococcus* would be a good general test organism.—W. H. M.

The Number of Micro-organisms taken must be fairly large if consistent results are to be obtained, the margin of error being enormously greater where small quantities of a culture are used with a loop than when greater quantities are taken with a spoon.

The Strength and Number of Dilutions should be as close together but extend over as wide a range as possible, in order that full data may be obtained. Further, the intervals should be, as far as possible, equal, taking the form of a percentage difference. Only when these precautions are taken can the curve described be satisfactory.

The Time during which the Disinfectant is allowed to act, must be more or less arbitrary, but it appears to be fair to all disinfectants (some of which act quickly and others more slowly) to take a mean between two extremes than to take any fixed point between two extremes ($2\frac{1}{2}$ and 30 minutes).

Temperature.—A more or less arbitrary temperature being the mean temperature met with in the temperate zone, was adopted in the experiments. It has long been known that the carbolic acid coefficient of a disinfectant may vary enormously according as the work is done with solution and emulsions kept at 55° F., or maintained at a temperature of 80° F., but the authors believe that even now the great importance of the working temperature has not been realised.

Kingzett and Woodcock supplied an elaborate paper. Coal Tar Emulsions (ready prepared), Homogeneous Coal Tar preparations (clear liquids, yielding emulsions with water) and "Chemical Germicides" (Formalin and H_2O_2) were compared with Phenol. They modified the Rideal-Walker method to make it suitable for use with H_2O_2 and Formaldehyde germicides for which, according to them, the process is not satisfactory. Ten drops of a forty-eight hours' broth culture were added to the usual amount of diluted disinfectant under examination, two loopfuls of this solution being taken according to the customary routine for sub-culture. Employing increased temperatures the "chemical" disinfectants showed a higher efficiency. It is pointed out that R.-W. Coefficients become greatly depreciated when the same preparations are examined by the Martin and Chick method (employing 3% added dried faeces), *e.g.* two Coal Tar Emulsion Disinfectants, with R.-W. Coefficient of 22 and 18, drop to 1.6 and 1.5 by this method. Very similar drops occurred with homogeneous coal tar preparations. Added "organic matter" (not faeces) did not cause so marked a drop. They are strongly in favour of the Rideal-Walker test. The R.-W. test may very well serve to determine the relative germicidal values of similarly prepared preparations of a coal tar nature: it is not applicable for ascertaining the real or relative values of other disinfectants of a different chemical nature, nor does it, of course, afford any measure of other chemical attributes and properties possessed by them and not shared by coal tar preparations.—P.J. ii./10,157.

R. T. Hewlett in criticising Woodhead and Ponder's method thought an ordinary standard loopful should be sufficient for "seeding"; he said, the apparent necessity for the large spoon (containing 0.1 Cc.) is due to the fact that McConkey's medium is not delicate enough. Extension of time limit from 15 to 30 minutes is of questionable utility, at least for "Coal Tar" Disinfectants. A standard temperature, *e.g.*, 65° F. should always be employed. Claims that the mean between $2\frac{1}{2}$ and 30 minutes raises the Coefficient over that obtained at an early period. Rideal-Walker method thought to be more stringent.—P.J. ii./10,159.

Modification of the "Lancet" Method. A 24 hour culture of *B. Coli* is used; the experiments are always carried out at a temperature of 20° C.; the proportion of culture to disinfectant is 0.1 Cc. of culture to 5 Cc. of disinfectant.

tant; the amount of inoculation into subculture tubes is measured by loops instead of by spoons; the medium for subculture is prepared from beef extract according to the American standard and has a reaction of +1.5, the titration being carried to a point where the pink colour is distinctly perceptible. Instead of the wheel a block containing four or six grooves is used. Other minor details are given including a table of dilutions. Great variation in results may be obtained with Rideal-Walker method—it is not a method to advise for the examination of disinfectants.—*Journal of Infectious Diseases*, Jan., 1911, per leader in "*Lancet*," i./11, 43.

Comparison of "Lancet" with "Rideal-Walker" Results.

In preparing our 15th Edition, we conducted experiments with a view to making a comparison between the figures given respectively by the R.-W. and the Lancet methods.

Starting with the view that the R.-W. method if correctly conducted gives results *slightly higher than the Lancet method*, e.g., in proportion of about 9 or 10 to 7, which we believe is accepted by some workers, we found on operating with a well-known Cresylic disinfectant (Lancet figure 5.8) that we obtained the R.-W. figure of 8.

On the other hand, another Cresylic Disinfectant gave by the 'Lancet' 4.8 and by R.-W. method 14! We think therefore the 'R.-W.' method may give exaggerated figures.

Experiments to determine how rapidly antiseptics pass through animal membrane as estimated by destruction of bacteria. The membranes employed were celloidin and the omentum, mesentery, diaphragm and skin of the rabbit. Carbolic Acid and Mercuric Chloride were without action in 24 hours. There was, however, one exception, i.e., a 5% Aqueous Phenol Solution was found to pass through the diaphragm of a rabbit in five minutes.

The most effective proved to be Iodine and Alcohol.—*L. i./11*, 1366.

The Edmunds' Cell method using Agar Slabs to determine the diffusibility of antiseptics is referred to, Vol. I., p. 35, and this vol., p. 118. Edmunds and his co-workers found Iodine in such circumstances a poorly diffusible bactericide.

Phenol apparently has a selective action on bacteria in sewage filters—very few types appear in the filtrate—more especially *B. liquefaciens fluorescens* and a chromogenic. Experiments showed that the liquefying organism had no action or only a slight one on the Phenol in proportion 8.4 to 16.5 per 100,000 of water, even after a month or more. When the chromogenic organism was added the Phenol content was decreased, disappearing completely in a few days. The Phenol is thought to be oxidised by the bacteria.—*Nat.* Nov. 24/10.

Experiments using Petri Dishes of Nutrient Agar containing pieces of metal inoculated with *B. fluorescens* showed that metals produced a kind of death zone around them—this sterile zone varies with different metals. Strong action in this way was shown by thallium, cobalt, silver, mercury, antimony, and arsenic. Slight power on the other hand was seen in the case of bismuth, lead, nickel, iron, aluminium, zinc, and copper.—*L. i./11*, 1373.

G. T. Morgan and E. A. Cooper determined the influence of the chemical constitution of certain organic Hydroxyl and Aminic Derivatives on their germicidal power by a somewhat modified Carbolic Coefficient Method, using *B. Typhosus*, *Staphylococcus Pyogenes Aureus* and *B. Coli*. The germicidal power of the alcohols is far less than that of the phenols the primary alcohols being more active than the secondary and tertiary alcohols. The carbolic-acid coefficients of the cresols and *m* and *p* nitrophenols are greater than unity, and two of the isomeric dihydroxynaphthalenes ($\beta\beta = 2:3$ and $2:7$) are very active in aqueous solution, although the dihydroxybenzenes do not show any exceptional bactericidal power. The germicidal action of the aromatic amines is very low and stands in marked contrast to that of the aliphatic amines which, with the exception of the ethylenediamine gave high coefficients, the number for *n*-heptylamine being 24.3. The hydrogenation of an aromatic amine raises the coefficient, *ac*-tetrahydro- β -naphthylamine giving the value 5.3. The lowest coefficient (.18) for any base was given by pyridine.—*C.D. ii./12*

Coal Tar Disinfectants examined as to toxicity by infection of mice, determining thereby the least fatal dose comparing with Phenol. The same relation probably exists for man. Many labelled non-poisonous are toxic to mice.—Worth Hale, Bull. No 88, Hyg. Lab. Washington, D.C.—L. ii./13. 1204.

So far it will be seen we have mainly dealt with various Proprietary (mostly Cresylic) Disinfectants. In 1914 we operated on a number of recognised antiseptic bodies and have incorporated our results in the following pages. We also took into consideration a number of substances not hitherto examined—which might have antiseptic power—these also are indicated.

Somewhat curiously amongst the *relatively potent* are **Thorium Nitrate, Acetic Acid, Acid Citric, Acid Lactic, Acid Picric, Alcohol 70%** (the last mentioned being in confirmation of existing knowledge), **Potassium Chlorate, Saccharin Insoluble** whilst on the other hand the *impotency* to kill disease organisms of the following chemicals—**Antimony Potassium Tartrate, Arsenious and Arsenic Oxide. Arsamin, and Acetone**—is of interest.

Quite recently (1921) we have been at work upon numerous new preparations—**Acriflavine, Allantoin, Cinchonidine Salts, Colloidal Iodine, Crystal Violet, Dakin's Solution, Diffusol, Eusol, Malachite and Brilliant Green, Methylene Blue** and others, and have incorporated our findings.

All the results have been obtained by procedure strictly in accordance with the "Lancet" Method. For practical purposes an exact determination of the *Coefficient* is not necessary. *All that the practitioner wants to know is, whether a specific disinfectant will kill the organism in a reasonable time—if in the prescribed 2½ minutes so much the better*—this we have stated, also in many cases a figure for the result of 30 minutes contact.

A good disinfectant must have high germicidal power, and it must not be affected markedly by heat. It should have no corrosive action on metals; it must be miscible or form a fine emulsion with water and so on.

* Prof. Hewlett some years ago made the useful suggestion to employ a torch flame generated by a cyclone burner burning paraffin, similar to that used on night works, &c., for disinfecting walls, floors, &c.

Disinfection. Mechanism of.

Formaldehyde, Halogens, Mercuric Chloride, Acids and Alkalis form chemical combinations with Proteins. The action of Phenols and Cresols in regard to Proteins is not understood. Alcohol depreciates whilst Hydrochloric Acid increases effect of Phenol. Meta-cresol precipitates Proteins in lower concentration than Phenol hence it is more active. E. A. Cooper has evolved a theory that the action of Phenols on bacterial proteins is not directly bactericidal. The germicidal action which follows absorption does not seem to be the result of a typical chemical union between the Phenols and bacterial

Proteins.—L. ii./12,1387. The question is raised as to affinity between Essential Oils and bacterial Protein which gives these Oils such remarkable power—we refer to this under *Olea Essentialia*, *Antiseptic Powers*.—p. 117.

Specificity in Antiseptics.

Specific antiseptic treatment of infected wounds is suggested as the outcome of an interesting research. Criticism of the 'Physiological' School is noted. The latter relies on varying concentrations of Sodium Chloride utilising the physical factor of a dressing solution, viz., relative tonicity.

Data are given *re* inorganic and organic acids operating on growths of *Streptococcus Pyogenes*, *Staphylococcus Aureus*, *B. Pyocyaneus* and *B. Aerogenes Capsulatus*. There is no great divergence either in strength or in point of the organisms in case of the inorganic acids (Hydrochloric and Nitric Acid) tested, but *re* the organic acids there are points of interest, *e.g.* Tartaric and Malic Acids are active on *B. Aerogenes*, whilst relatively non-active on the cocci. Malic Acid is further fairly active against *B. Pyocyaneus* and most active of all against the gas bacillus.

With regard to generally recognised antiseptics, Phenol and Cresol are more active against *Streptococcus* than against *Staphylococcus*, and showed very little activity against the gas bacillus. Quinine Hydrochloride showed its greatest activity against the gas bacillus, was fairly active against *Streptococcus*, but little on *Staphylococcus* and less still on *B. Pyocyaneus*. Sodium Fluoride is less active against the cocci and *B. Pyocyaneus*, but active against the gas organism. The best against the gas organism of all the bodies tried seem to be Salicylic Acid and Quinine Hydrochloride.

Clinically the values of Acetic Acid Dressings 1% in *B. Pyocyaneus* cases; of Sodium Bicarbonate 1% in *Streptococcus* cases; of Cresol 0.1% and Dakin's Solution in *Staphylococcus* cases and of Quinine Hydrochloride 0.5% in gas bacillus cases, especially the latter—are proven. Quinine seems to be the only specific against this organism. Further study may discover dressings specific for one or more groups of bacteria.—K. Taylor, L. i./17,294,306.

SUMMARY OF OUR EXPERIMENTAL RESULTS.

The following have practical therapeutic value *i.e.*, they are germicidal (to *B. Coli*) in the strengths indicated:—

Acetanilidum	-	-	-	-	1 in 400
Acetonum	-	-	-	-	1 in 2
Acidum Benzoicum	-	-	-	-	1 in 500
„ Cresylicum	-	-	-	-	1 in 200
„ Hypochlorosum,	see Eusol				
„ Oxalicum	-	-	-	-	1 in 200
„ Picricum	-	-	-	-	1 in 400

SUMMARY OF OUR EXPERIMENTAL RESULTS—*continued*.

Acidum Salicylicum	-	-	-	1 in 1,000
„ Sulphuricum	-	-	-	1 in 200
Alcohol	-	-	-	70%
Argenti Nitras	-	-	-	1 in 2,000
Brilliant Green	-	-	-	1 in 100
Bromum	-	-	-	1 in 20,000
Chlorinum	-	-	-	1 in 75,000
Chloroformum	-	-	-	1 in 200
Dakin's Solution	-	-	-	} As used. See detail of work later.
Eusol	-	-	-	
Creosotum	-	-	-	1 in 300
Formaldehydum	-	-	-	1 in 50
Hydrargyri et Zinci	-	-	-	
Cyanidum (as dusting powder)	-	-	-	
Hydrargyri Iodidum (as Mercuric Potassium Iodide)	-	-	-	1 in 100,000
Hydrargyri Perchloridum	-	-	-	1 in 100,000
Hydrargyri Cyanidum	-	-	-	1 in 2,500
Iodum	-	-	-	1 in 50,000
Malachite Green	-	-	-	1 in 1000
Potassii Chloras	-	-	-	1 in 50
Potassii Permanganas	-	-	-	1 in 2,000
Saccharin Insoluble	-	-	-	1 in 40
Sal Alembroth	-	-	-	1 in 90,000
Sodii Salicylas	-	-	-	1 in 20
Thymol	-	-	-	1 in 1,500
Vesalvine S.	-	-	-	1 in 20

DETAILS OF THE WORK.

Acetanilide. 0.25% Solution killed *B. Coli* in $2\frac{1}{2}$ minutes
0.125% did not.—*W.H.M., Expt., 1914.*

Acetone. 50% killed *B. Coli* in $2\frac{1}{2}$ minutes, 40% did not.—
W.H.M., Expt., 1914.

Acidum Aceticum. 7% kills *B. Coli* in $2\frac{1}{2}$ minutes, 5% does
not kill.—*W.H.M., Expt., 1914.*

Active against *B. pyocyaneus* and successful clinically in infections
with this organism, *c.f. Specificity in Antiseptics, p. 348.*

Acidum Acetyl-Salicylicum. We have not conducted experiments
on the Carboic Acid Coefficient with this acid. The gradual hydro-
lysis which would occur at blood heat would vitiate the result. *R.*
Stockman states: A solution of strength 1 in 250 does not stop yeast
fermentation, hence any antifermentative or antibacterial action must
only occur when the Salicylic Acid is split off (Salicylic Acid 1 in 2,000
inhibits fermentation entirely and 1 in 5,000 greatly delays it).—*B.M.J.*
i./13,598.

Acidum Arsenicum. 1% of Arsenic Anhydride did not kill *B. Coli* in $2\frac{1}{2}$ minutes.

Acidum Arseniosum. 2% of Arsenious Anhydride did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Acidum Benzoicum. 0.2% killed *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Acidum Boricum. 1 in 25 (Saturated Solution) did not kill *B. Coli* in $2\frac{1}{2}$ or 30 minutes—and did not kill *Staphylococci* or *B. Typhosus* in 2 minutes.—*W.H.M., Expt., 1914.* In no sense a disinfectant, but used in sufficient quantity it is a food preservative. The figure necessary for milk preservation is variously stated; 1 in 500 is usually advised, *c.f. Milk Preservation.* 4% is usually employed as douche for the eyes and vagina and as mouth-wash.

Acidum Cacodylicum. 10% Solution did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Acidum Camphoricum. 0.5% (Limit of Solubility) did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Acidum Carbolicum (see also "*Lancet*" and Rideal-Walker Coefficients, *antea*). 1.1% killed *B. Coli* in $2\frac{1}{2}$ minutes; 0.7% killed in 30 minutes, not in $2\frac{1}{2}$ minutes.

Liquid Phenol (10% water added) is caustic and anæsthetic. 1% is used as vaginal injection, mouth-wash and gargle.

Solution 1 in 20 is truly germicidal for *B. Tuberculosis*.—*L.C.C. Report, L. i./02,758.*

The activity of this disinfectant on *B. Coli* is only slightly reduced by fæces and urine.—*Hewlett, i./09,816.* Alcohol diminishes activity of Carbolic Acid. Most Carbolic soaps of commerce are useless as disinfectants.—*L. i./09,818.*

Acidum Chromicum. $2\frac{1}{2}$ % killed *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.* Also kills *Staphylococci*. This strength is used for ulcerated gums.

Acidum Cinnamic. 1 in 1,250 prevents yeast growth, but 1 in 2,000 does not.—*R. Stockman, B.M.J. i./13,599.*

Acidum Citricum. 8% killed *B. Coli* in $2\frac{1}{2}$ minutes. 4% killed in 30 minutes, not in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Acidum Cresotinicum. With 1 in 1,500 Solution, ortho- and the meta-Cresotinic Acids prevented growth, while with Salicylic and para-Cresotinic Acid a few colonies developed, but growth was not nearly so abundant as in the control (sterile water). With 1 in 2,000 growth was obtained in all. In the case of *B. Coli* the Cresotinic Acid was more active than Salicylic Acid.—*R. May, B.M.J. ii./09,791.*

Acidum Cresylicum. 0.5% killed *B. Coli* in $2\frac{1}{2}$ minutes, 0.3% did not kill.—*W.H.M., Expt., 1914.* *C.f. antea and Liq. Cresolis Saponatus.*

Acidum Formicum. 5% Solution killed *B. Coli* in $2\frac{1}{2}$ minutes, 2% did not.—*W.H.M., Expt., 1914.*

Acidum Hydrochloricum. The acidity of the gastric juice probably serves as a protection against typhoid and cholera. *Ex-*

periments by the late A. Macfadyen support this view.—Hewlett, *L. i.*/09,743. Boer found that from 1 in 200 to 1 in 1,350 was necessary to kill anthrax, diphtheria, glanders, typhoid and cholera organisms, indicating variable resistance of different “non-spore-bearing organisms.”—*L. i.*/09,815.

Acidum Hydrocyanicum. (2% HCN). Does not kill *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., *Expt.*, 1914. Fumigation of trees is practised with this acid.

Acidum Hypochlorosum. See Dakin's Solution and Eusol in this chapter also, Vol. I.

Acidum Iodicum. 1 in 2,500 is deodorant and preservative. 1 in 500 is used as mouth wash and for ulcers.

Acidum Lacticum. 1% of actual Lactic Acid or less killed *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., *Expt.*, 1914.

Acidum Malicum. Vide “Specificity in Antiseptics,” p. 348.

Acidum Oxalicum. 0.5% Solution killed *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., *Expt.*, 1914. Hailer (“Chemisches Zentralblatt,” 1910,1) found adding Oxalic Acid increases the disinfecting power of Phenols.

We had occasion to examine several Cresylic Disinfectants for this body without finding it.

Acidum Picricum. 0.25% killed *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., *Expt.*, 1914.

0.165% Solution has the same bactericidal powers towards 24 hours broth culture of *B. typhosus* as 1% Phenol, the Rideal Walker coefficient being exactly 6.—H. L. Tidy, *L. ii.*/15,604.

Acidum Pyrogallicum. 1% did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., *Expt.*, 1914. 3% according to Rideal kills most organisms.

Acidum Salicylicum. 0.1% kills *B. Coli* in $2\frac{1}{2}$ minutes, 0.05% does not. (Saturated Solution is of strength 1 in 500). Must not be used to the eyes. 0.2% killed *B. Typhosus* in 2 minutes.

1 in 2,000 inhibits fermentation entirely, and 1 in 5,000 greatly delays it.—R. Stockman, *B.M.J. i.*/13,598.

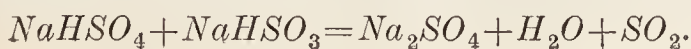
Active against *B. Aerogenes Capsulatus*, vide “Specificity in Antiseptics,” p. 348.

Acidum Sulphuricum. 0.5% Solution killed *B. Coli* in $2\frac{1}{2}$ minutes, 0.1% did not.—W.H.M., *Expt.*, 1914. 0.05% stated to be fatal to *B. Cholerae* after 15 minutes contact.—Rideal.

Acidum Sulphurosum. 1% of the Off. 5% Acid killed *Staphylococci* and *B. Typhosus* in $2\frac{1}{2}$ minutes.—W.H.M., *Expt.*, 1914.

Gaseous sulphurous Acid was until recently much used to disinfect rooms. The gas, however, is not powerful enough to kill Anthrax spores.

It was found that *B. Coli* and *S. Pyog. Aureus* were killed in 24 hours in a sealed room into which 20 ounces of SO_2 were passed. *B. subtilis* spores were not killed. R. mentions that a Bisulphate and Bisulphite together would be useful as they liberate SO_2 on moistening, thus :



Klein says although most pathogenic organisms do not thrive in an acid medium some putrefactive and zymogenic bacteria, e.g., B. subtilis, M. ureæ, will, e.g., in acid urine.

Acidum Tannicum. 2% Solution did not kill in $2\frac{1}{2}$ minutes. 40% Solution did not inhibit fungoid growth.—*W.H.M., Expt., 1914.*

Acidum Tartaricum. Vide “Specificity in Antiseptics,” p. 348.

Acidum Trichloraceticum. 1 in 500 solution failed to kill *Staphylococci* and *B. Typhosus* in $2\frac{1}{2}$ minutes. In throat affections (see Text) 1 in 1 or 1 in 2 of Glycerin is astringent. 1 in 4 on a tampon with endoscope in gonorrhœa has been used. Less painful than Silver Nitrate.

Acriflavine. The antiseptic power of this substance has been the subject of ardent and burning discussions, v. Vol. I., p. 294, et. seq.

We found that 1 in 20 Solution did not kill *B. Coli* in $2\frac{1}{2}$ minutes but 1 in 100 killed in 30 minutes.—*W.H.M., Expt., 1921.*

Alcohol. 70% killed *B. Coli* in $2\frac{1}{2}$ minutes. 35% did not.—*W.H.M., Expt., 1914.* It is not in itself reliable as an antiseptic.

The maximum efficacy as a disinfectant is obtained with Alcohol of 70% strength. Stronger Alcohol does not penetrate Albumin so readily and is, therefore, not so active as a germicide.

Allantoin. Saturated solution did not kill *B. Coli* in 30 minutes.—*W.H.M., Expt., 1921.*

Allyl iso-sulphocyanidum. See *Oleum Sinapis Essentiale.*

Allyl Sulphide. 1 in 100 in a special Saponaceous Solution killed *B. Coli* in $2\frac{1}{2}$ minutes. Less dilutions failed to kill. Further 1 in 500 killed in 30 minutes. C.A. Coefficient is approximately 2. A simple Aqueous Solution cannot be used in sufficient strength.—*W.H.M. by Expt., 1914.*

Aluminii Chloras. $2\frac{1}{2}$ % Solution kills *B. Coli* in 30 minutes but not in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Ammonia. 1% of Ammonia did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., 1914.*

A solution of Ammonia containing 0.5 Cc. of strong solution of Ammonia in 600 Cc. of Normal Saline killed *B. typhi* and *B. cholerae* and partially *B. Coli* and *M. pyogenes aureus* in 4 hours. In the case of cholera the germicidal effect takes place in a few seconds.—*Hewlett, L. i./09,743.*

Antimonii et Potassii Tartras. 5% solution did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., 1914.*

Argenti Nitras. 1 in 2,000 solution killed *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., 1914.*

Lotions, Eye Drops, and Urethral Injections 1 in 1,000 up to 1 in 500. In eye work is more penetrating and active than the organic silver compounds on the market (see Text).

Boer found that from 1 in 4,000 to 1 in 20,000 killed anthrax, glanders, diphtheria, cholera, and typhoid organisms in 2 hours—i.e., a very variable resistance by different non-spore bearing bacteria.—*L. i./09,815*

Arsamin. 10% solution did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Arsenic. See *Acidum Arsenicum et Arseniosum.*

Auri Cyanidum. 1 in 2,000,000, according to Koch, of $\text{Au}(\text{CN})_3$, dissolved in Potassium Cyanide checks growth of *B. Tuberculosis.*

Borates and Boric Acid. See *Acidum Boricum.*

Brilliant Green. 1 in 100 killed *B. Coli* in $2\frac{1}{2}$ minutes; 1 in 750 killed in 30 minutes, but not 1 in 1,000.—*W.H.M., Expt. 1921.*

Bromum. 1 in 20,000 killed *B. Coli* in 30 minutes, 1 in 8,000 $2\frac{1}{2}$ minutes.—*W.H.M., 1914.* Was found by Arbourgh and confirmed by Koch, to be the most powerful of all destructives to Anthrax and Tubercle bacteria.

Calcii Hydras (Slaked Lime) is not an antiseptic of any note.

Calcii Permanganas. See *Potassii Permanganas.*

Carbonis Bisulphidum. Antiseptic, but odour and inflammability prevent its use.

Chlorinum 1 in 75,000 kills *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., 1914.* A cold saturated solution of Chlorine Water contains 0.634% by weight. (The activity of chlorine water probably owes its power to Hypochlorous Acid.)

It is satisfactory to note that 'Chlorine Gargle,' which contains about 0.125%, is a potent antiseptic against this and other organisms.

Suitable for treating drinking water. No potable water would be likely to contain more than a small fraction of the number of cholera vibrios introduced into different waters used experimentally in the investigation in question (ranging from about 1,000 to 18,000 per Cc.). It was concluded that most waters would be freed from cholera vibrios, if treated with 1 of chlorine per million for 15 minutes.—*L. ii./10, 1213; c.f. Vol. I., p. 50. Also Vol. II., p. 420.*

c.f. also **Eusol.**

Chloroformum. 0.5% solution kills *B. Coli* in $2\frac{1}{2}$ minutes, 0.2% does not.—By *Expt., W.H.M., 1914.* Our experiments showed further that 0.2% did not kill *Staphylococci*, nor *B. typhosus.*

Chromates. See *Acid Chromic.*

Cinchonidine Sulphate, saturated solution, did not kill *B. Coli* in 30 minutes — *W.H.M., Expt., 1921.—c.f. Quinine Salts.*

Colloidal Solutions of Copper, Gold, Mercury, Platinum, Selenium and Silver were tested after $2\frac{1}{2}$ minutes, 30 minutes and 16 hours contact with *B. Coli.* With the exception of Mercury, which killed at $2\frac{1}{2}$ minutes, none had any disinfectant power at $2\frac{1}{2}$ and 30 minutes. After 16 hours Silver and Gold (electrically prepared) inhibited growth. Gold (chemical), Platinum, Copper and Selenium did not inhibit growth. (Two experiments were done on all except Mercury, three experiments).—*W.H.M., Expts., 1914.*

Colloidal Iodine E.P. diluted 1 in 100, kills *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., Expt. 1921.*

Collosol Argentum (c.f. *Vol. I., p. 362*), is stated to kill *B. Coli* in 10 seconds.

Copper Salts. See below.

Creosote (Morson). 1 in 350 killed *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., 1914.* 1 in 150 is used in phthisis, &c., see text.

Crystal Violet. 1 in 100 did not kill *B. Coli* in 30 minutes.—*W.H.M., Expt. 1921.*

Cupric Chloride. Kraemer has advised for treating water 1 in 5,000. Is a stronger antiseptic than copper sulphate for the treatment of water supplies. A solution containing 1 of copper in 5,000 will kill *B. Typhosus* in slightly over an hour and *B. Coli* in an hour. (*Staphylococcus Pyogenes Aureus* is killed in less than two hours by a 1 in 7,000 copper sulphate solution.—*J. Sanitary Inst., 1904.*)

Cupri Sulphas. 1% killed *B. Coli* in 30 minutes but not in 2½.—*W.H.M., 1914.* 1% is used for irrigation, see Vol. I., Text.

Dakin's Solution (diluted 1 in 6), 1 in 20,000 killed *B. Coli* in 2½ minutes, 1 in 50,000 killed in 30 minutes. Tested same day as made.—*W.H.M., Expt. 1921.*

Diffusol. This Lysol equivalent was highly spoken of for its diffusible power in the Hunterian Oration, 1915, c.f. Vol. I., p. 35.

1 in 100 killed *B. Coli* in 2½ minutes.—*W.H.M., Expt. 1921.*

Ethyl Iodidum. Readily destroys *B. Tuberculosis*. (R.).

Eucalyptol. See p. 116.

Eusol. 1 in 2,000 killed *B. Coli* in 2½ minutes and 1 in 7,000 in 30 minutes. This was the result of trial same day as made. It deteriorates greatly on keeping. In a second expt. with Eusol 2 days old, 1 in 2,000 did not kill in 2½ mins., nor did 1 in 6,000 in 30 minutes, but 1 in 3,000 did.—*W. H. M., Expt. 1921.*

Flavine. The antiseptic power of this substance or its absence has been much discussed, see Vol. I., p. 294, and Acriflavine, p. 352.

Fluorinum. More active than Chlorine. Fluorides and Silicofluorides (c.f. Salufer) are antiseptic. Fluoric Acid and Ammonium Potassium and Sodium Fluorides are used in the brewing trade. 0.3% will prevent the acidity of butter, and in a trial found not to be injurious to health. (R.). c.f. Specificity in Antiseptics, p. 348.

Formaldehyde 2% (=5% Formalin) kills *B. Coli* in 2½ minutes. 1% Formaldehyde does not kill in 2½ minutes.—*W.H.M.,* by experiment, 1914, but a small proportion inhibits growth (multiplication). Formaldehyde, it would appear, is a slowly acting germicide. c.f. our Experiments under Hexamine, Vol. II., p. 77. Kingzett and Woodcock, for example, found that when heated (incubated) in the ordinary way it has a coefficient 0.38, while if allowed to act for 1¼ hours its destructive power becomes greater than Phenol. We believe that very similar, and even more marked results would be obtained with many antiseptic bodies. 1 to 2% is suitable for wounds, instruments and rooms. As deodorant, 5 or 10% is sufficient.

Its use as milk preservative in Great Britain is now forbidden. For detection in Milk, v. Milk Preservatives.

10% solution is useful for disinfecting human discharges. Tubercle bacilli in sputum are killed by 5% solution in 1 hour.—*L. ii./07, 1178.*

It probably owes its antiseptic power to the ease with which it abstracts oxygen and becomes Formic Acid, a process which causes the breakdown of organic matter.—*Pharmacol. 71.*

Fumigation of Rooms.

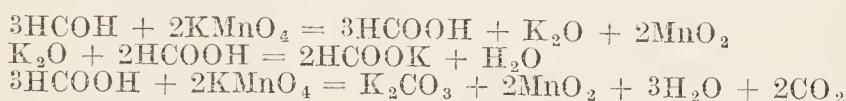
Hewlett says Formaldehyde is probably more active than Sulphurous Acid in general disinfection.

Kenwood concluded from results with fumigation by Formaldehyde and by 1% Spray of Sublimate that there was little to choose between the two. Washing infected rooms with soap equally important. He recommended mixing $142\frac{1}{2}$ Gm. of Permanganate and 285 Gm. of Formalin in a metal tray 7 inches in diameter and 3 to 4 inches deep—heat is generated and Formaldehyde is caused to escape.

Formanganate Disinfectant. Consists of 16 ounces of 40% Formaldehyde solution and a box of two briquettes, made with 15% Portland Cement, each of 120 Gm. Potassium Permanganate for 1,000 cubic feet of air space. Warmth—at least 65° F.—and moisture 60 to 65% humidity, are essential for proper disinfection with formalin.

A simple "home made" apparatus is described: 8 ounces of Potassium Permanganate is required for each pint of Solution of Formaldehyde in disinfecting every 1,000 cubic ft. of air space. Wet sheets suspended in the room make the air damp,—a great advantage in Formaldehyde disinfection. There must be no live fire or flame in the room as the liberated gas is slightly inflammable.—P.J. ii./10,125.

J. Rutherford Hill has investigated the products of interaction of these bodies and comes to the conclusion that the general reaction taking place is as follows:—



For disinfection of hospital wards, etc., with Potassium Permanganate at war prices the method does not commend itself. It would be preferable to simply evaporate Formalin in an open vessel over a Bunsen or spirit flame.—P.J. ii./16,589.

For disinfecting books.—Formalin vapour is useless. Exposure to a temperature of 180° — 190° C. in a hot air steriliser for an hour or two on three successive days is effective.—M.A., 1911,707.

0.8% of Formaldehyde kills *B. Diphtheriæ* in 10 minutes, *B. Dysentericæ* in 60 minutes, *B. Typhosus* in 40 minutes, *Staphylococcus pyogenes albus* in 60 minutes, *Staphylococcus pyogenes aureus* in 40 minutes. 2% Formaldehyde killed *Staphylococcus pyogenes albus* in 30 minutes, *B. Dysentericæ* in 40 minutes, *Staphylococcus pyogenes aureus* and *B. Typhosus* in 20 minutes. 4% Formaldehyde killed all the non-sporing organisms investigated in less than 10 minutes except *B. Dysentericæ* and *Staphylococcus pyogenes aureus*, which, however, were killed after 10 minutes.—B.M.J.E. ii./08,7.

Glycerin is preservative for vegetable preparations (c.f. *Glyce-tracta*), but, as anticipated, our experiments gave + with pathogenic organisms.

The presence of glycerin more or less completely destroys the antiseptic power of such useful antiseptics as *Thymol*, *Phenol*, *Boric Acid*, *Mercuric Chloride*, etc.—H. P. Goodrich, B.M.J. i./17,647.

Guaiacol is stated to have greater bactericidal power than Phenol, i.e., as 5 : 2.

Helmitol. 5% Solution did not kill *B. Coli* in 30 minutes.—*W.H.M., Expt., 1914.*

Hexamethylene Tetramine. 10% did not kill *B. Coli*, but a less proportion inhibits growth gradually in acid solution—hence effect in bacilluria.—*W.H.M. by expt., 1914. (c.f. Hexamethylene tetramine, page 77, this volume, and Vesalvine 'S'.)*

Hydrargyri Ammonio-Chloridum ((*Sal Alembroth*)). 1 in 90,000 killed *B. Coli* in $2\frac{1}{2}$ minutes, 1 in 120,000 did not.—*W.H.M.*

Hydrargyri Cyanidum. 1 in 2,500 killed *B. Coli* in $2\frac{1}{2}$ minutes 1 in 3,000 did not.—*W.H.M., 1914.* As gargle 1 in 10,000 is used. We should prefer 1 in 5,000 at least. For fibroid rhinitis tampons impregnated with 1 in 2,500 have been employed (c.f. *Text*). It is extremely poisonous.

Hydrargyri et Zinci Cyanidum. We found 2 minutes with the 33% paste (q.v.) killed *Staphylococci* and *B. typhosus*. As first dressing to wounds 3% gauze and wool and paste are non-irritant.

Hydrargyri Iodidum Rubrum used as *Mercuric Potassium Iodide*. 1 in 100,000 killed *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M.* For hands 1 in 4,000, *Collyrium* 1 in 5,000, wounds 1 in 7,000, vaginal douche 1 in 10,000. Not so irritant as the *Perchloride*.

Hydrargyri Oxycyanidum. 1 in 1,000 or more kills *B. Coli* and *B. Typhosus*. As pigment in syphilis 0.2 to 0.6%.

Hydrargyri Perchloridum 1 in 100,000 killed *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M.* It is the most powerful antiseptic known. Its intensity is increased by presence of *Hydrochloric Acid*, e.g., 1 in 500 with 1 in 120 of acid, for disinfecting excreta. (*Woodhead* says $\frac{1}{2}$ % *Hydrochloric Acid*.) It is precipitated by soluble organic matter. For eye, nose and mouth lotion 1 in 4,500, vagina 1 in 10,000. For linen, rooms, gynaecologists' hands and superficial wounds 1 in 10,000 to 1 in 1,000.

The antiseptic power (on *B. Anthracis Spores*) of *Equimolecular Solutions* of this salt, the bromide and the cyanide, is in this order—corresponding to the degree of dissociation in the three solutions.—*Pharmacol.*

RELATIVE ANTISEPTIC POWERS OF CORROSIVE SUBLIMATE AND ITS DOUBLE SALTS WITH RESPECTIVELY, AMMONIUM CHLORIDE, POTASSIUM CHLORIDE AND SODIUM CHLORIDE.

In some experiments which we conducted (January 1912) to compare the antiseptic powers of these combinations respectively with that of *Sublimate* in aqueous solution and equimolecular equivalents, in each case it was found that 1 in 250,000 of *Sublimate* either alone or so combined failed to kill *B. Coli* in 15 minutes. A 1 in 100,000 Solution in each case prevented growth of the organism. c.f. *Statements of earlier Researches, Vol. I., p. 463, also Prof. Delepine, p. 343*).

Our test was conducted (in two separate series of experiments) by adding 5 drops of 24 hours culture of *B. Coli* to 5 Cc. of each of the solutions and after 15 minutes contact transferring a loopful of each mixture to 5 Cc. of McConkey's Bile Salt medium and incubating 24 hours at 37° C.

It is evident, therefore, that the formation of the double salts in question has no particular effect on the antiseptic power of Sublimate. Possibly a relatively larger proportion of one or other of the salts might have the effect.—W. H. M.

Bactericidal action of pure Mercury Oxycyanide and a sample containing much Cyanide found to be equal against *B. Coli*, *Staphylococcus Pyogenes*, etc. Sodium Chloride enhanced bactericidal action by increasing absorption by the protoplasm of the germicide organism. Paul and Krönig's statements may be taken as a guide, but biological relations must be fully considered before a general rule is formulated.—P.J. ii./13,607.

A little Hydrogen Sulphide should be added to subcultures in testing power of this substance to prevent the sublimate carried over with the bacteria from interfering with results.—L.i./09,815.

Sodium Chloride reduces power on anthrax spores.—L. i./09,818.

Hydrogenii Peroxidum (10 Vol.). 12% did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., 1914. Is variously employed: even the strong official solution may be employed on mucous membrane. It is used in the Budde process of sterilising milk (q.v.) and is contained in Sanitas q.v.

Iodine. 1 in 50,000 kills *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., 1914. It is much employed as a first aid dressing and to sterilise catgut (q.v.). Iodine is potent against other organisms, but unfortunately, to check *B. Anthracis* once established in the human body 12 Gm. of Iodine would have to be in constant circulation in the system. (Koch.)

Consult in particular our Vol. I., p. 503—505, which gives a complete resume of the use of Iodine, also Vol. I. p. 1019.

T. Maben and J. S. White experimented with Tincture of Iodine and Aqueous Solution of Iodine (with Potassium Iodide), both $2\frac{1}{2}\%$ strength and diluting same down to their minimum lethal strengths upon *B. Typhosus*. They found the killing power of iodine in the form of Alcoholic or Aqueous solution on this organism is at least four times more powerful than that of a solution of carbolic acid of the same strength.—C.D. Jany. 30, 1915.

Iodoform. A paste of Iodoform will kill *B. Coli* and *B. Typhosus* in $2\frac{1}{2}$ minutes, but not *Staphylococci* invariably. It is used as a bladder injection with glycerin, also as a dusting powder and wool dressing.

It has been stated, and is probably true, that Iodoform crystals may be infected with adherent organisms, and the same remarks apply to Corrosive Sublimate (dry).

Iron. Frankland proved that Metallic Iron is destructive to bacteria. Ferrous Sulphate is stated to be mildly antiseptic. Ferric Sulphate and Chloride check fermentation and bacterial growth.

Lead Salts. Are antiseptic. 2.0 Gm. per litre are stated to preserve broth.

Liquor Aluminii Acetatis P.G. kills *B. Coli* in 30 minutes but not in $2\frac{1}{2}$ minutes.—W.H.M., Expt., 1914.

Liquor Carbonis Detergens. We found a 2% solution killed *B. Coli*, *B. Typhosus* and *B. Anthracis* in $2\frac{1}{2}$ minutes. A remedy in skin affections, strength used 1 in 8 up to 1 in 160 (see Text).

Liquor Cresolis Saponatus. 0.5% killed *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., Expt., 1914. C.A. Coefficient 1.5. For midwifery 1% is usually employed.

Lister's Antiseptic. See *Hydrargyri et Zinci Cyanidum*.

★**Lysoform.** 2% kills *Staphylococci* and *B. Anthracis*, but at least 10% is necessary for *B. Coli* and *B. Typhosus*.—W.H.M., Expt., 1912.

It is employed for wounds and irrigation. Contains Formaldehyde. Lathers with water. Non-poisonous. For further details v. Vol. I., p. 128.

Magnesii Sulphas. 20% solution did not kill *B. Coli* in 30 minutes.—W.H.M., 1914.

Malachite Green. 1 in 1,000, but not 1 in 2,000, killed *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., Expt., 1921.

Malourea, Syn. Veronal. 1% (at 37° C.) failed to kill *B. Coli* in 30 minutes.—W.H.M., Expt., 1914.

Mercuric Chloride. See *Hydrargyri Chloridum*.

Mercuric Cyanide. See *Hydrargyri Cyanidum*.

Mercurochrome. 1 in 100 (but not 1 in 500) killed *B. Coli* in $2\frac{1}{2}$ minutes and 1 in 850 (and probably weaker) killed in 30 minutes.—W.H.M., Expt., 1921.

Methylene Blue. 1 in 100 did not kill *B. Coli* in $2\frac{1}{2}$ minutes; 1 in 750 killed in 30 minutes but not 1 in 1,000.—W.H.M., Expt., 1921.

Naphthalene. A paste we found will kill *B. Typhosus* but not invariably *Staphylococci*.

Enemata of 8 grains have been used. Parasitic in scabies, 10 to 20% solution in oil. Is commonly employed as deodorant in closets, but not a disinfectant in this way.

Naphthol β. A paste we found will kill *B. Typhosus* and *Staphylococci*.

Oily Solution 10% has been used. This appears to be active.

Neutral Red. 1 in 100 did not kill *B. Coli* in $2\frac{1}{2}$ minutes nor in 30 minutes, W.H.M., Expt., 1921.

Nicotinæ Tartras. 10% solution kills *B. Coli* in 30 minutes, but not in $2\frac{1}{2}$ minutes.

Novarsenobillon. 1 in 100 did not kill *B. Coli* in 30 minutes.—W.H.M., Expt., 1921.

Oleum Allii. See *Allyl Sulphide*.

Oleum Sinapis Essentiale. 0.1% did not kill *B. Coli* in 30 minutes.—W.H.M., Expt., 1914.

Oils Essential. See Vol. I., p. 581, Vol. II., p. 114 et seq.
Oxygen in the nascent condition, e.g., from Potassium Permanganate, is antiseptic.

Ozone in the dry state has little action on micro-organisms.

*** Paraform.** Using a paste with water we found to kill *Staphylococci* and *B. Typhosus* in 2 minutes. The spontaneous vapour (Formaldehyde) has been used to maintain instruments and catheters in sterile condition. For fumigation of rooms during and after disease. Tablets (15 grains) are made. 20 of these disinfect 1,000 cubic feet space.

Persulphates are Antiseptic. Ammonium Persulphate. 1 to 2% kills Cholera Organisms and others in a few minutes.

Sodium Persulphate. 2% solution did not kill *B. Coli* in 30 minutes.—W.H.M., Expt., 1914.

Phenazonum. 10% solution did not kill *B. Coli* in 2½ minutes.—W.H.M., Expt., 1914.

Phenoloid Disinfectant. Lanceli Carbolic Coefficient 7·8, v. Vol. I. p. 37.

Potassii Bromidum. 20% did not kill *B. Coli* in 30 minutes.—W.H.M., Expt., 1914.

Potassii Chloras. 2% kills *B. Coli* in 2½ minutes; 1% kills *B. Coli* in 30 minutes, but not in 2½ minutes.—W.H.M., Expt., 1914.

Potassii Permanganas. 1 in 2,000 kills *B. Coli* in 2½ minutes; 1 in 5,000 does not, but does so in 30 minutes.—W.H.M., 1914. It is a good deodorant.—Rideal. In presence of organic matter, however, its antiseptic power is reduced by it oxidising the organic material.—B.M.J. ii./09, 212. (Calcium Permanganate approximates the Potash Salt in potency.)

In gonorrhœa 1 in 1,000 gargle and vaginal douche 1 in 5,000 of either salt are employed. Bousfield found sewage as control in his experiments give an average of 239 colonies in 0·00001 Cc. against sewage with 1 in 5,000 permanganate 99, 1 in 2,500 23, and 1 in 1,000 one colony—the time of contact being 12 hours. Further work showed that the time element is of no importance whatever—results after 5 minutes contact were quite as good as after 4 hours. A source of error in the Rideal-Walker method was overcome in these tests by diluting the disinfectant after 12 hours' contact to 1 in 100,000 of the strength at which it had been allowed to act for the purposes of the experiment before making the cultures. The general conclusion was that 1 in 1,000 is efficient and that if such a mixture of permanganate and sewage is deodorised it is also sterilised.—L. ii./08, 1078.

Pyoktanin. 1 in 500 or even 1 in 2,000 arrests *B. typhosus* and *B. Coli*.—Rideal.

Pyrogallol. See Acid Pyrogallic.

Quinidine Sulphate, saturated solution, did not kill *B. Coli* in 30 minutes.—W.H.M., Expt., 1921.

Quininæ Hydrochloridum. In experimental gas gangrene found to be more effectual than phenol—especially active in a menstruum

of pus.—K. Taylor, *L. ii.*/15,538,977. *c.f. Specificity in Antiseptics*, p. 348.

Quininæ Hydrochloridum Acidum. 10% Solution did not kill *B. Coli* in $2\frac{1}{2}$ minutes.—W.H.M., *Expt.*, 1914.

Quininæ Sulphas. 1 in 500 Solution necessary for killing infective organisms (in a common cold).—*L. ii.*/08,1661. See also Quinine Sulphate, Vol. I.

Quininæ Sulphas Acidus, stated to have C.A. Coefft. 0.5. It will inhibit growth of fresh Typhoid cultures in 1 in 30,000 dilution.—*P.J. i.*/15,287.

Rescorin. 3.5% killed *B. Coli* in $2\frac{1}{2}$ minutes, 1% did not kill in 30 minutes.—W.H.M., *Expt.*, 1914.

Is non-irritant on mucous membrane, e.g., bladder, 5% is used. As collyrium 2%, as enema 0.5%. See also Text.

Saccharin, Insoluble. 0.25% killed *B. Coli* in $2\frac{1}{2}$ minutes.

Saccharin, Soluble. 5% did not kill *B. Coli* in 30 minutes.—W.H.M., *Expt.*, 1914.

Sal Alembroth. See **Hydrargyri-Ammonio-Chloridum**.

Scarlet Red (water soluble) 1 in 50 did not kill *B. Coli* in $2\frac{1}{2}$ or in 30 minutes.—W.H.M. *Expt.*, 1921.

Soap. Though not giving a high Carbolic coefficient is generally acknowledged to be germicidal. We tried a 2% solution which was useless on *B. Coli*, *B. Typhosus* and *Staphylococci*, but this does not simulate the process of scrubbing or washing.

Sodii Chloridum. 33% Solution did not kill *B. Coli* in 30 minutes.—W.H.M., *Expt.*, 1914.

Sir A. E. Wright says 5% will completely arrest the growth of pyogenic organisms.—*L. ii.*/15,1063.

Sodium Fluoridum. Active against *staphylococcus aureus* and *strepto. pyogenes* and *B. pyocyaneus*, and fairly so against *B. aerogenes capsulatus*. *c.f. Specificity in Antiseptics*, p. 348.

Sodii Metabisulphis. 2.5% in Glycerin kills *Staphylococci*, but did not kill *B. Typhosus* in $2\frac{1}{2}$ minutes.—W.H.M., *Expt.*, 1914. A pigment this strength has been used for thrush.

Sodii Persulphas. See **Persulphates**.

Sodii Salicylas. 5% killed *B. Coli* in $2\frac{1}{2}$ minutes, 1% did not.—W.H.M., *Expt.*, 1914.

A feeble germicide and antifermentative. It has almost no action on yeast or bacteria.—R. Stockman, *B.M.J. i.*/13,598. See also Water Examination for *B. Coli*.

Sodii Sulphas Acidus. For water sterilising see Text (Vol. I.). One Antityphoid Tablet to the pint of water is stated to destroy *B. Typhosus* and *B. enteritidis* in 15 minutes. We found it killed *B. Typhosus* and *Staphylococci* in 2 minutes, in above proportion.

Sodii Sulphis. 1 in 500 we found did not kill *Staphylococci* or *B. Typhosus*.

Sodii Taurocholas. 20% solution did not kill *B. Coli* in 30 minutes.—W.H.M., *Expt.*, 1914.

Strychninæ Hydrochloridum. $2\frac{1}{2}\%$ solution did not kill *B. Coli* in 30 minutes.—*W.H.M., Expt., 1914.*

Sulphonal. 1 in 450 (saturated solution) did not kill *B. Coli* in 30 minutes.

Tar. See *Liquor Carbonis*.

Terpin Hydrate. 0.25% said to arrest Tubercle Bacilli. We have not experimented with this.

Therii Nitras. 1% killed *B. Coli* in $2\frac{1}{2}$ minutes.—*W.H.M., 1914.*

Thymol. 1 in 1,500 killed *B. Coli* in $2\frac{1}{2}$ minutes, 1 in 3,000 kills in 30 minutes but not in $2\frac{1}{2}$ minutes.—*C. A. Coefficient 19 approximately.—W.H.M., 1914.*

1 in 800 is used as gargle. It is soluble 1 in 1,500 water and 1 in 200 glycerin.

Ratimoff places Thymol amongst the 4 highest Antiseptics.—*L. i./13,368.*

Thymol Disinfectant. A potent germicide. *Lancet C.A. Coefficient 10.4. Vide Vol. I., p. 745.*

Toluol (c.f. Benzol, Vol. I., which it resembles). Did not hinder growth of *Staphylococci*.

Trikresol. *C.A. Coefficient 2.5.* 1 in 2,000 appeared to hinder *Staphylococci* and *B. Typhosus* which ultimately developed (in 60 hours). $\frac{1}{2}\%$ on the other hand, killed *B. Coli* and *B. Typhosus* but not *Staphylococci*. In general surgery $\frac{1}{2}$ to 1% . Eye wash 1 in 1,000 to 1 in 2,000.

Uranii Nitras. 5% killed *B. Coli* in 30 minutes but not in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Veronal, See *Malourea*.

Vesalvine 'S.' 5% killed *B. Coli* in $2\frac{1}{2}$ minutes. $2\frac{1}{2}\%$ killed *B. Coli* in 30 minutes but not in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Zinc shaken with water stated to kill *B. Typhosus* and *B. Coli communis* in a few hours. Copper has a similar effect. (*Kraemer.*)

Zinci Chloridum. The results of our tests showed that Zinc Chloride was not of much avail. 1 in 1,000 failed to kill *B. Typhosus* and *Staphylococci* in $2\frac{1}{2}$ minutes. 1 in 500 is an astringent lotion. It is very poisonous. A $2\frac{1}{2}\%$ Solution was found to destroy bacteria, but *Koch* found even 5% would not kill Anthrax spores.

Zinci Permanganas. 1 in 5,000 prevented growth of *B. Typhosus* and *Staphylococci*. Employed similarly to the Potash Salt. Absence of irritation is a feature.

Zinci Sulphanilas. 1% killed *Staphylococci* but did not kill *B. Coli* or *B. Typhosus*. 1 in 250 killed *Staphylococci* but not the others.

Zinci Sulphas. 2% killed *B. Coli* in 30 minutes but not in $2\frac{1}{2}$ minutes.—*W.H.M., Expt., 1914.*

Zinci Sulphocarbolas. $2\frac{1}{2}\%$ killed *B. Coli* in $2\frac{1}{2}$ minutes, 1.25% did not.—*W.H.M., Expt., 1914.*

These results are given in Tables. See Vol. I., p. 942 and Vol. II. p. 348, 349.

See also Antiseptic Powers of Essential Oils
p. 114.

Sunlight according to Koch will kill the *Tubercle Bacillus* in from a few minutes to 5 or 7 days, according to the thickness of the medium. Light, in short, is one of the most important agencies for diminishing the number of bacteria.

B. Typhosus is killed rapidly by sunlight. 240,000 organisms in 2 hours were reduced to nil (in India).—L. i./09,742.

Heat owes its bactericidal power to its coagulating effect on bacterial proteins. Moist heat is best because apart from its penetrating power it is well-known the protein in the dry condition coagulates at a much higher temperature than when moist.—Hewlett, L. i./09,815.

Filters. The 'Pasteur-Chamberland' or 'Berkfeld,' or similar apparatus of the porous candle type are efficient instruments.

ANALYTICAL MEMORANDA.

CHEMICAL TESTS & MICROSCOPIC METHODS for THE EXAMINATION OF URINE, BLOOD, FÆCES, &c.

The **Specific Gravity** of Urine (at 60° F.) is usually between 1.015 to 1.025. The volume passed per diem (24 hours) in health is about 50 ounces (1500 Cc.). The capacity of the bladder is, as an average, 20 ounces (600 Cc.).

Temperature makes a considerable difference in taking the Sp. Gr., e.g., a urine Sp. Gr. 1.015 when passed may be 1.020 when cooled to room temperature. The specific gravity increases about one point for every fall of 8° F. of temperature.

In women the Sp. Gr. frequently ranges higher than in men—1.035 to 1.040 is not at all uncommon even in health and not entirely accounted for by small consumption of liquid.

Acetone and Allied Bodies in Urine.

Legal's Test :—

Fresh concentrated Sodium Nitroprusside [$\text{Na}_4\text{Fe}_2(\text{CN})_{10}(\text{NO}_2) + 4\text{H}_2\text{O} = 595.914$.] Solution (soluble 1 in $2\frac{1}{2}$) added to a specimen or its distillate containing Acetone, made slightly alkaline with caustic potash, produces a red colour which changes rapidly to yellow. On adding Acetic Acid a reddish-violet colour is produced, which changes to blue on standing.

Rothera's Test is usually given as follows:—The liquid to be tested is saturated with Ammonium Chloride. A few drops of 5% solution of Sodium Nitroprusside are added and then 1 to 2 Cc. of Ammonia Solution. In half an hour a red colour is produced. The test is sensitive to 1 part in 20,000.

One may also proceed thus—Add a little Ammonia so that it remains on top as a clear solution with the nitroprusside and urine below. If acetone is present in 1 to 3 minutes a well marked ring of magenta (petunia) appears at the juncture of the liquids and spreads upwards. An orange red ring is to be distinguished from the acetone ring.

Lange uses 15 Cc. Urine, $\frac{1}{2}$ to 1 Cc. of Glacial Acetic Acid, a drop of freshly made Nitroprusside Solution and 1 Cc. of strong Ammonia Solution by which 1/400th% can be detected. Cambridge.

Acetone having a specific gravity of 0.8 will obviously decrease the specific gravity of a urine, and may lead to error if its presence be unsuspected in diabetic urine. This is apt to occur in an advanced stage of the disease.

* "**Endolytic Tubes**" (*c.f.*, pp. 372 and 400) are made containing Sodium Nitro-prusside and Ammonium Chloride to be used in conjunction with a little washing soda or Liquor Potassæ.

Iodoform Test. Distil the sample and make distillate alkaline with potash, add a little iodine solution (not an alcoholic solution). The formation of iodoform, recognised by yellow turbidity and the odour, indicates presence of acetone. *Microscopic Examination* is more conclusive than the odor.

Determination of Acetone in Urine—formation of Iodoform in the usual way and converting this into Silver Iodide and weighing.—Y.B.P. 1919, 56.

Acidity of Urine, Estimation, see **Uric Acid**, this section.

Aceto-Acetic Acid. *Syn.* DIACETIC ACID, $\text{CH}_3\text{CO}\cdot\text{CH}_2\cdot\text{COOH}=\text{102.068}$.

Gerhardt's Test for. Ferric Chloride gives red coloration. A few drops of Potassium Citrate solution instantly remove the colour. Reacts also with Sodium Nitroprusside as Acetone, *vide infra*. The acid is soluble in ether, and may be removed by it after acidifying the specimen with Sulphuric Acid. Dilute Ferric Chloride solution shaken with this ethereal solution, becomes red.

Occurs in urine in cases of gastric ulcer.

In employing the ferric chloride test care must be taken to distinguish from colour produced by salicylic acid and compounds, *e.g.*, salicin, aspirin, diuretin, salol. Also other substances in the urine may respond.—W. H. Hurtley, L. i./13,1160. For Hurtley's new test, *v. infra*.

Boil the urine first for five minutes, then apply test. As the aceto-acetic acid is converted by so doing into acetone there is considerable reduction in colour if dependent on aceto-acetic acid but is unaltered if due to salicylic acid.—B.M.J. ii./04,114; L. i./07,511.

In diabetes the ferric chloride reaction in urine indicates by the colour produced the amount of diacetic acid present and is hence measure of the acidosis when of mild degree. The *B*-oxybutyric acid, which cannot be conveniently tested for, is roughly proportional to the aceto-acetic acid present. Coma is always accompanied by a deep reaction of the urine with ferric chloride. The appearance of the reaction indicates that a benign case of diabetes has become a severe one, and that the tissue metabolism has become profoundly altered. It is important to keep a close watch on this test, both as to its presence or absence, and also as to the depth of colour obtained. In early stages patient may be still amenable to treatment. A direct change to a strict carbohydrate free diet is unnecessary and dangerous as it often gives rise to a ferric chloride reaction when none is present or increases one already existing. Gradual reduction is just as efficacious.—L. i./10,1002.

"**Endolytic Tubes**" (*c.f.* **Acetone** above, and pp. 372, 400) containing Ferric Chloride Solution for testing are made.

The Ferric Chloride test does not discriminate between Acetone and Aceto-Acetic Acid. Proceed with either Riegler's or Hurtley's Test, infra.

B. Derham (L. ii./15,227) has a useful note on the significance of Acetone Bodies in the urine. Describing the case of two children who became indisposed by indiscretion, he concludes: "If there be no sugar and the aceto-acetic acid be transient, especially if the patient be young and symptoms of gastric catarrh be present, the correct deduction would be that the site of the aceto-acetic acid manufacture is the intestinal canal."

Riegler's Test.—Differentiates Acetone and Aceto-acetic Acid. 10 Cc. of the specimen are acidified with 5 drops of 30% Acetic Acid and 5 drops of Lugol's Iodine solution are added. Shake out

with 2 to 3 Cc. of Chloroform. No colour appears if Aceto-acetic Acid be present. The Iodine is absorbed by the Aceto-acetic Acid forming a colourless compound.—W. G. Smith, L. i./16,1118. (B. Dérham, L. ii./15,229, uses Methylene Blue Solution—compare Bela & Ondrovich's method, *infra*.)

Hurtley's Test for Aceto-Acetic Acid

To 10 Cc. of urine add 2.5 Cc. of Concentrated Hydrochloric Acid and 1 Cc. 1% Sodium Nitrite. Shake and allow to stand two minutes. Add 15 Cc. of strong Ammonia followed by 5 Cc. of 10% Ferrous Sulphate or a solution of Ferrous Chloride of equivalent strength (2 Gm. Fe in 100 Cc.). Shake and pour into a 50 Cc. Nessler glass. Do not filter. Violet colour forms slowly.

Acetone does not respond to the test.—It is exceedingly delicate. It is assumed that iso-nitroso-acetone is first formed which then colours with the ferrous sulphate.

The test can be rendered quantitative colorimetrically. The highest amount of Aceto-acetic acid found was 0.4%.—L. i./13,1160.

Arnold's Test is useful. Two Solutions are required (a) 1 Gm. Para-amino-acetophenone dissolved in a little water with aid of 2 Cc. of Hydrochloric Acid and the solution made up to 100 Cc. (b) Sodium Nitrite 1%. Mix 2 volumes of (a) and 1 volume of (b), add an equal volume of urine and a drop or two of strong Ammonia. Reddish precipitate forms. To a portion of this a large excess of **Hydrochloric Acid is added** (1.5 Cc. to 2 Cc.)—**a fine purple is formed.** It is best to filter the urine through animal charcoal first—more urine can be used by so doing.—L. i./13,1160.

Iodine Absorption Test, Bela and Ondrovich.—5 drops of Acetic Acid 50% are added to 5 Cc. of Urine, then 1 drop of 1 in 500 Methylene Blue or *q.s.*, to give blue tint. Then titrate with N/10 Iodine Solution until a red tint appears.

$2\text{I}=\text{CH}_3\text{CO}.\text{CH}_2\text{COOH}$. *Vide* L. i./13,1160.

Acetone bodies in the urine and clinical significance. J. E. Piper found diabetic urines, when fresh, contained 70% or more of the Acetone as Diacetic Acid. L. ii./13,535.

Iodic Acid, Test for.—Add to 1 or 2 Cc. of normal urine 2 Cc. of 10% Iodic Acid Solution and 3 Cc. Chloroform. Uric Acid, etc., reduce the Iodic Acid—the Chloroform becoming coloured with the Iodine. Now add a little of the specimen to be tested and shake thoroughly. If Aceto-Acetic Acid present the colour disappears, if absent it is intensified.—M., 1906.

Hydroxy- or β -Oxy-Butyric Acid $\text{CH}_3.\text{CHOH}.\text{CH}_2\text{COOH}=104.084$ and any increase in the amount of fat (lipæmia—granules stained by Osmic Acid), should be carefully looked for in the urine and blood respectively of diabetics. It may be extracted from the specimen with ether, and gives a reddish-violet colour with Ferric Chloride *vide* above—the diacetic acid gives approximate index of this acid. Occurs only if Diacetic Acid be also present, *c.f.*—B.M.J.E. i./06,49. The specimen may be fermented to remove sugar, precipitated with lead acetate and ammonia; if the filtrate be levorotatory β -Oxy-Butyric Acid is probably present.—B.M.J. i./03,1205.

In diabetes, Acetone, Diacetic Acid and β -Oxy-Butyric Acid are excreted in this order as the disease advances, and if metabolism can be improved they disappear in the inverse order. The main source of Acetone is the imperfect metabolism of fat, either of feed or the body—B.M.J.E. ii./06,49. *c.f.* Acidosis *postea*.

In some of the gravest forms of renal disease albumin may be absent from the urine, at any rate temporarily. Conversely serious renal disease should not be diagnosed merely by finding blood or albumin in the urine.

In following the progress of a case it is of importance to examine the mixed urine of a whole day, because if, *e.g.*, the percentage in a specimen examined were to suddenly show a rise, the quantity excreted per diem might be the same if the amount of urine, had decreased owing to the consumption of less liquid, or change of diet, occupation, &c., and *vice versa*. The same remark, of course, applies to all pathological constituents in the urine.

With regard to the various views as to reasons for appearance of β -Oxy-Butyric Acid, Diacetic Acid and Acetone in the Urine Mann says the tendency at the present time is to consider them as products which are found during the splitting up of fat in the tissues generally.—according to some authorities in the muscles and large glands particularly, such as the liver.

Occurrence of acetonuria in infectious diseases. Acetone occurs much more constantly in diphtheria and scarlet fever than in enteric, of 96 cases of diphtheria 87 were found to have acetonuria and of 197 cases of scarlet fever 167 showed its presence also.—L. i./10,1346.

Acidosis—B.M.A. DISCUSSION.

It is known that the organism normally meets the presence of Acids in the system by using an available alkali that is not essential for other purposes, namely Ammonia. Those animals that have from their food considerable Ammonia available have the greatest power of withstanding Acid intoxication and *vice versa*. As a consequence Ammonia is excreted in abnormally large amounts in the urine and the presence of Ammonia in same in abnormal amounts becomes an index of the acid intoxication. In human beings similar circumstances maintain in certain pathological conditions. *B*-Oxybutyric Acid is the only acid known to occur in the body in amounts sufficient in themselves to be dangerous from the effects as Acid. Acetone and Diacetic Acid are oxidation products of this acid. Diacetic Acid is not directly toxic. Acetone probably occurs only in very small amounts,—it may have but a small direct share in any severe toxæmia, but it may perhaps damage the kidneys, thus tending to add renal insufficiency to the pre-existing toxæmia. The administration of alkalis often does good. *B*-Oxybutyric Acid has a large share in producing the intoxication that occurs in diabetes, but Acid intoxication does not wholly explain the conditions. Acidosis relatively slight is also seen in starvation. Various poisonings, especially some of the narcotics, in digestive disturbances, in cyclic and periodic vomiting, in acute yellow atrophy and phosphorus poisoning in eclampsia and vomiting of pregnancy. The occurrence in diabetes is known to be dependent on inability to use Carbohydrates, and coincident excessive uses of fats. In starvation large amounts of body fat are burned.

The Author suggests the possibility that the attack of the Organic Acids may in more or less extent be upon the lipoids of the nervous system and resemble that of narcotics, others show that the acids may act in part as narcotics through the influence of the undissociated molecules upon the lipoids. With regard to the manner in which β -Oxybutyric Acid accumulates rather than Diacetic Acid or Acetone, it appears that a definite equilibrium is maintained between the two acids. Probably normally the oxidation does not go over to Diacetic Acid.

Various substances have been suggested to control acidosis,—*Alcohol has proved of most value.* Woodyat found that Glyceric Aldehyde largely reduces acidosis,—it is probably a normal combustion product of sugar. The best control must for the present be to gradually train the Carbohydrate metabolism back to the point where it can utilise more Carbohydrate and thus do away with the acid intoxication.—D. L. Edsall, B.M.J. ii./10,1033.

In the discussion on this paper the dietetic treatment of diabetes was dwelt upon. A diabetic may be able to metabolise lævulose, oat-meal or potato starch when unable to assimilate other Carbohydrates. In other forms of acidosis dextrose is given,—if necessary per rectum. The subject of Acidosis in delayed Chloroform poisoning is also discussed.—B.M.J. ii./10,1036, *et seq.*

The presence of acetonæmia in diabetes is caused by Aceto-acetic Acid decomposing. This in turn is formed from β -Oxybutyric Acid,—in grave cases 30, 50, or even 70 Gm. of this acid may be excreted in the course of 24 hours. A diabetic may die with some of the symptoms usually associated with coma, although he has little β -Oxybutyric Acid in his blood, but it is generally accepted that the characteristic air hunger and coma, which follow upon it, are actually due to acidosis.—A. E. Garrod. B.M.J. i./11,1416.

Phthisis and diabetes frequently occur in the same family. The former is decreasing, the latter is on the increase. Is it due to open air treatment with its forced appetite? Are we trying to strengthen relatives of phthisical patients and over-straining their powers of metabolism? Is there any significance in the appearance of β -Oxybutyric Acid in diabetes and the absence of sweating?—B.M.J. i./10,1006.

To combat acidosis in diabetics with large quantities of glucose seems more scientific and more likely to give benefit than alkalis,—this tackles the condition nearer its source than attempting to neutralise an already fully neutralised series of Acids, which are probably of no more importance than some of the other known chemical abnormalities, *e.g.*, the presence of Creatin,—which accompany this condition. The term acid intoxication applied to gastro-enteritis, delayed Chloroform poisoning, etc., is a misnomer. The amounts excreted in these conditions is small in comparison with that in diabetic coma, and are thought not able to produce symptoms.—L. ii./11,10.

Acidosis Index.—A clinical measure of the quantity of Acetone bodies excreted in the urine,—T. Stuart Hart, Quarterly Jl. of Med., July, 1912, p. 419.

In every case of severe pregnancy toxæmia Acetone and Aceto-acetic Acid were detected—in several milder cases both were absent. **Rothera's Test** *v. antea* modified was used for the former. 5 Cc. of urine are shaken up with Ammonium Sulphate, *q.s.*, to saturate: 0.5 Cc. of strong Ammonia Solution is added, then 3 or 4 drops of freshly made Sodium Nitroprusside Solution. If Acetone is present purple colour is produced.—L. i./13,1366.

Fridericia's Carbon Dioxide Tensimeter for estimating CO_2 tension of the alveolar air.

Acidosis in diabetes mellitus is dealt with,—A. P. Beddard, M. S. Pembrey & E. I. Spriggs, B.M.J. ii./15,389, as the result of work at Guy's Hosp. Analyses of the carbon dioxide in the alveolar air of the lungs afford an index of the degree of acidosis and a guide in treatment and prognosis. The significance of alveolar carbon-dioxide determinations in the treatment and prognosis of diabetes is dealt with by E. P. Poulton, *ibid*, p. 392, who describes the apparatus used for obtaining and analysing the alveolar air for clinical purposes.

Albumin Tests.

Proteins occurring in urine are classed as—

(a) **Serum Proteins**: *Serum albumin*, *Serum globulin* or *paraglobulin* and *fibrin*.

(b) **Compound proteins**: *Nucleo-albumin*, *Chondro-albumin*, *Taurochol albumin* and *Mucins*.

(c) **Proteolytic products**: *Albumoses*.

Secondary Albumoses excepted, all the urinary proteins are precipitated by Nitric Acid. With most, excepting Albumin, the precipitate thus formed is *soluble with heat*.

ALBUMINURIA denotes the presence in the urine of Serum Albumin accompanied by varying proportion of **Globulin**.

Albumin is precipitated by excess of mineral acid, but not by Acetic Acid.

Acetic Acid with heat. Fill a test tube about half full with filtered urine, slightly acidify with dilute acetic acid. Boil the upper portion. Albumin, if present, will precipitate in the form of a cloud which will be insoluble after cooling on further addition of acetic or nitric acids in moderate amount.

Differential Diagnosis in cases of Albuminuria.

The presence of Albumin seldom matters until its amount is sufficient to respond both to the Acetic Acid and boiling test, and the Cold Nitric Acid Test,—there is no need to trouble about the other Albumin tests,—there is such a thing as too great delicacy for clinical work.

In doing the Acetic Acid and boiling test it is well to add a few drops of the Acetic Acid to the opalescence if formed, *i.e.*, after boiling unless the urine be alkaline to start with, in which case it must be rendered slightly acid before being boiled. If the cloud formed disappears it is Calcium or Magnesium Phosphate, if it dissolves with effervescence it is carbonate,—if it remains unaltered or becomes thicker (flocculent) it is Albumin.

A fallacy is with regard to **Nucleo-protein**,—this is precipitated by Acetic Acid, and it is possible for a cloud of Phosphates to be cleared up by the latter, and yet for a faint cloud of nucleo-protein to come down in the place of the phosphates in such a way as to suggest that the original cloud was not wholly soluble in the acid, and therefore that albumin is present when it is not. There are three ways of obviating this source of fallacy; the *first* is to add a single drop of dilute nitric acid to the suspicious cloud that remains after the addition of acetic acid; if it is due to albumin, it will persist or even increase, whilst if it is due to nucleo-protein the nitric acid

will disperse it ; the *second* is to perform the cold nitric acid test for albumin as described subsequently—nucleo-protein will not give a definite localised white ring with it ; and *thirdly*, a control test may be done, acetic acid being added to another specimen of the urine without boiling, and the cloud due to any nucleo protein present compared with the cloud in the acidulated and boiled specimen.—Herbert French, B.M.J. i./11,417.

Clinical Significance of Albuminuria.—The amount of albumin detected at any time does not measure the importance of the albuminuria. A large output naturally implies failure of nutrition, but a small quantity may be of equal danger. Note Sp. Gr. and color.

The finding of Casts may be of assistance, but too much importance need not be paid to presence of a few hyaline casts (especially in centrifugalised sediment). They are likely to be found, when albumin is present, in acid urine. They may be found in any of the forms of albuminuria not associated with definite renal disease, etc. Casts and albumin are often absent from the urine for considerable time in chronic interstitial nephritis. It is not safe to base a diagnosis on the non-finding of casts where serious structural renal change is suspected. Temporary albuminuria is frequently associated with athletic exercise. The sphygmograph is often of assistance in distinguishing functional from organic types of albuminuria.

A large amount of albumin without blood or pus may generally indicate chronic tubal nephritis : confirm by high Sp. Gr. microscopic examination of deposit, and appearance of patient. A small amount in a middle-aged or elderly man will probably point to chronic interstitial nephritis. In a young man a mere trace may be only the evidence of a functional albuminuria and the diagnosis must rest on negative evidence to a large extent, a most important factor being relatively high Sp. Gr. unless this has been influenced by nervousness or recent consumption of a large quantity of liquid.—N. Tirard, L. ii./09,1062.

Albuminuria caused by toxic effects of poisonous substances, *e.g.* lead, mercury, phosphorus, cantharides, etc.—B.M.J. E. ii./07,81.

Various forms of albuminuria classified and described :—(a) With renal tube casts. (b) With renal tube casts and with pus. (c) Without tube casts. Also albuminuria due to (1) febrile conditions, (2) heart failure conditions, (3) so-called 'physiological albuminuria.'—Herbert French, B.M.J. i./11,418.

Albuminuria in pregnancy, Significance of.—A marked increase in cases of post partum hæmorrhage found, not necessarily in eclampsia but in cases of albuminuria.—B.M.J. ii./12,1009. See also L. i./13,1366.

Nephritis, Interstitial and Parenchymatous. Investigation and Treatment. Points of difference :—

Interstitial Nephritis.

- (1) Edema absent.
- (2) Protein present in urine but often slight or moderate in amount.
- (3) Chlorides present in normal amount.
- (4) Urea concentration (urinary) decreased.
- (5) Tendency to increase of urea and other nitrogenous products in the blood.
- (6) Cardio-vascular changes marked.
- (7) Tendency to uræmia.

Parenchymatous Nephritis.

- (1) Edema present.
- (2) Protein present often in very large amount.
- (3) Chlorides diminished or may be absent.
- (4) Urea concentration normal.
- (5) No retention of nitrogenous products in the blood.
- (6) Cardio-vascular changes less marked.
- (7) Uræmia less frequent.

Albuminuria *per se* is not necessarily an indication of renal disease, and may be present in individuals whose kidney function is apparently quite normal.

The **best test** for protein is **Salicyl-sulphonic acid**. It is very delicate. Add a few drops of 25% solution to $\frac{1}{2}$ inch of the specimen in a test-tube. Examine also for casts.

The extent of involvement of the renal tissue is best found (1) by estimation of **urea in the blood**, (2) by the **urea concentration** test, (3) diastatic activity of urine.

(1) The average urea content in blood is 15 to 40 mgr. per 100 Cc. Above 40 is abnormally high. Urease contained in Soya Bean is used. It converts urea quantitatively into Ammonium Carbonate, but has no effect on other nitrogen constituents. (The hydrolysis is complete in 15 minutes.) The Ammonia from the Ammonium Carbonate is liberated by alkali and passed into standard Acid. **Caprylic Alcohol** is used in conjunction with the Soy Bean flower. See for further details pp. 414, 415. Estimation of blood urea, however, gives information only in advanced cases of renal disease.

(2) **Urea concentration** is most helpful. Patients with defective kidneys are incapable of passing urine with a high concentration of urea even after a large dose of urea by the mouth. Normally a person after a dose of 15 Gm. urea should after 1 or 2 hours pass urine containing 2 to 4% urea.

The patient in the test takes this amount dissolved in 100 Cc of water and the urine is examined 1 and 2 hours afterwards. The urea is estimated by a modified Gerrard's apparatus. 8 Cc. of Nitrogen is equivalent to 0.5% Urea. (4 Cc. of urine used.)

(3) **Diastatic test** is used in conjunction with the urea concentration test. When the urea test gives a low result, the amount of diastase in the urine is in general found to be low.

The test depends on the presence of diastase in the urine. It is obtained from the blood which in turn gets it from the pancreas. Diastase activity is estimated in terms of the amount of starch which a definite volume of the urine will change in a given time (starch used as indicator). 24 hours specimen in general is best. High diastatic value is nearly always indicative of efficient renal action.

Solutions required (a) 0.1% soluble starch solution, (b) 0.9% NaCl, (c) N/10 Iodine solution.

The following mixtures are made in test-tubes:—

Tube No.	Urine, Cc.	N. Saline, Cc.
1	1.0	—
2	0.6	0.4
3	0.3	0.7
4	0.2	0.8
5	0.1	0.9

When these are ready add 2 Cc. starch solution, mix and incubate at 37° C. for $\frac{1}{2}$ hour. Then remove and fill to within an inch of the top with cold water. This stops ferment action. Add one drop (or a few more) of the Iodine to each beginning with No. 5, and shake. The last two tubes will still be blue, but No. 3 will be colourless or faintly pink. If this is so, No. 3 tube contains just enough urine to change the 2 Cc. of starch. The unit denoting the change is obtained by dividing this 2 by the amount of urine in tube 3, i.e. $\frac{2}{0.3} = 6.6$.

As already stated, a high diastatic content (in cases cited 15, 20, etc.) is good prognostically and a low one (1 and <1) bad.

With regard to treatment, Epstein's advice that patients suffering from marked œdema or ascites resulting from parenchymatous nephritis should receive liberal protein diet is substantiated. Large doses of UREA given in such cases resulted in disappearance of the dropsy. 30 Gm. or more per diem persevered with. Bad cases have been cured.

In interstitial cases where nitrogen retention is more or less well marked protein especially meat is on the whole contraindicated. Milder cases are, however, probably not benefitted by strict dietetic limitations. The whole question of protein diet in kidney disease requires much investigation.—H. MacLean & A. E. Russell, L. i./20, 1305.

The average urea content was found to be 1.6% in the case of patients under observation in hospital. When the kidneys are damaged the concentration falls below that figure. That the specific gravity of the urine is consistently low in advanced granular kidney disease is a well recognised fact.

Salt retention is a characteristic of the œdematous or tubal type of nephritis just as urea retention is characteristic of the chronic interstitial or cirrhotic type.—C. R. Box, B.M.J. i./20,356. See also *Urea Estimation chapter*.

Albuminuria. Incidence of in 60,000 men examined. Salicyl-sulphonic acid used. It is undoubtedly one of the most reliable and delicate reagents—six drops of saturated solution to about $\frac{1}{2}$ inch of urine in an ordinary test-tube. Total with gross albuminuria after allowing for pus, etc., about 5%.—H. Maclean, B.M.J. i./19,94.

Egg Albumen in simulated Albuminuria, methods of detection.—Y.B.P. 1919, 57, 59.

Albumin Detection, by heating upper parts of tubes in steam bath. G. Bousfield, L. i./20,97.

Influenza as an ætiological factor in nephritis.—W. W. D. Thomson and H. F. Macaulay, L. i./20,481.

Asapro (Calcium Beta-naphthol-Sulphonate) precipitates albumin, peptone, &c., from acid solution. On boiling, peptone and albumose redissolve, albumin remains.

Carbolic Acid (saturated solution in absolute alcohol) has been used as an albumin test, but is not so delicate as Salicyl-sulphonic Acid, but the latter (see below) may be too delicate for clinical work. Further, the milkiness produced by the Phenol emulsifying with the water is a drawback.

Ferrocyanic Acid Test Pellets.

Potassium Ferrocyanide, $K_4Fe(CN)_6 + 3H_2O = 422.388$, and Acetic or Citric Acid mixed in solution set free Hydroferrocyanic Acid. In about 4 Cc. of urine an acid pellet is first dissolved, next a ferrocyanide pellet is added; if albumin is present a precipitate is formed. Does not precipitate peptones. May also be applied as a ring test.

Meta-Phosphoric Acid, $HPO_3 = 80.048$.—A fresh solution of a little of this acid is added to the clear filtered urine. A cloud or precipitation indicates presence of albumin.

Millon's Reagent.—**Nitroso-Nitrate of Mercury.**—Dissolve Mercury 3 Cc. in Fuming Nitric Acid 27 Cc. without heat and dilute the resulting solution with an equal volume of Distilled Water. With albumin or urea this gives a yellow, then red colouration on heating.

Nitric Acid Test.

(See also Roberts' Test *infra* for modifications.)

Nitric Acid is placed in a test tube and the filtered urine, or diluted filtered urine, carefully 'layered' on to it. A white ring at the juncture of the liquids indicates presence of albumin; confirm by another reliable test. Not so delicate as the **heat and Acetic Acid**, but will show 1 in 12,000 at once. Bilious urines may produce play of colours characteristic of Gmelin's test. For *fallacies with the test*, *vide* below.

The test may also be applied by heat—*i.e.* add a little Nitric Acid mix and boil the upper portion.

Glass Capsules of Nitric Acid containing one minim are convenient.

A solution of Citric Acid 10 Gm. in Water 7.5 Cc. may be used as confirmatory test. Apply by layering in similar manner—if mucus present the Citric Acid test will cause turbid ring.

In the Cold Nitric Acid Test *white rings more or less like albumin rings* are obtained by—

1. *Albumoses.*—These generally occur in association with albumin; should they occur alone, the ring with Nitric Acid will disappear with warming, to reappear on cooling, and there will be no cloud with the heat test.

2. *Bence-Jones's Albumose.*—This occurs with albumin, gives a ring with nitric acid that disappears on warming, to reappear on cooling; with the heat test a dense cloud appears at about 60° C. to disappear on further heating to boiling point. (*Vide* also *Albumoses* p. 373).

3. *Nucleo-albumin*.—The ring with this is not in contact with the nitric acid, but higher up and diffuse; it may be a real difficulty in diagnosis from albumin, for it is also precipitated by acetic acid, and may therefore give a cloudiness with the boiling test. The methods of avoiding this fallacy are mentioned under the Acetic Acid and boiling test.

4. *Urates*.—These may form a cloud near the Nitric Acid if the urine is very concentrated; the cloud will disappear on gentle warming, to reappear on cooling, so that it may also be mistaken for albumose; this fallacy may be avoided by diluting the urine with plain water before the nitric acid test is employed.

5. Resins, etc., see next reference.—B.M.J. i./11,417.

Copaiba Balsam, Sandal Oil and Turpentine—treated patients pass urine which cannot be tested for albumin with Nitric Acid as the whole precipitate—albumin and resin dissolve in the alcohol usually added to dissolve the resin. The addition of strong alcohol is however applicable if chronic acid be used as a test—also in case of patients treated with cubebs and coal tar. A false precipitation also occurs in case of patients treated with terpin hydrate.—L. ii./o6,1459.

In lobar pneumonia, the urine gives a dense white or dirty white ring or only a haze *above* the junction of the urine and the acid by Heller's test. Sometimes it only appears after the urine has stood an hour or more, whilst in others it appears immediately. If the urine is turbid it must first be filtered. In cases where the reaction appears day after day the prognosis is favourable—if it disappears before the crisis or immediately after, unfavourable symptoms are experienced. The substance is apparently not of the known albumoses. The urine must be fresh.—R. C. Holt.—B.M.J. ii./10,79.

Picric Acid Solution.

Mann warns against the voluminous precipitate which one occasionally gets with Esbach's reagent giving a fictitious estimation. Many albuminous urines give a pale blue with the Biuret reaction without any tendency to violet; others will give a reddish purple. Such urine indicates by the reddish color some hydrolytic change and will give the incorrect reading referred to.

Picric Acid 10 Gm., Citric Acid 20 Gm., dissolve in about 900 Cc. boiling water, cool and add water to 1,000 Cc. This reagent is used for the approximate determination of albumin by an Albuminometer which is about six inches long and 0.6 inch in diameter; the graduations on it are the results of experiment and indicate approximately 0.1 up to 0.7% albumin.

By comparison with a standard dried albumin solution, 1 in 1,000 and by heating to 180° F. and centrifugalising, the process can be terminated in a few minutes.

For exact determinations, albumin should be precipitated by some suitable reagent, itself nitrogen-free, *e.g.*, carbolic acid or tannin and the washed precipitate, dried and weighed, or better, the nitrogen contained in it should be estimated by a **Kjeldahl** analysis, the amount of nitrogen found being multiplied by the factor 6.3 to obtain the amount of proteins.

N.B.—Methylene blue—in case of patients undergoing treatment with precipitates picric acid solution.

The administration of alkaloids may cause urine to give a precipitate with picric acid, but this is redissolved on heating to the boiling point.

Roberts' Albumin Test.—Nitric Acid 1 part, Solution of Magnesium Sulphate (10 in 13) 4 parts. Is found to be very satisfactory—advantage, high density. Slope the tube containing a

little test solution and allow the urine to slowly run down into it with a dropper.

A further modified Nitric Acid Test:—

Ammonium Nitrate may be used instead of Magnesium Sulphate.

After obtaining ring shake slightly—the whole of the urine becomes turbid. This is not the case if ordinary Concentrated Nitric Acid is used, as turbidity dissolves at once.—J.C.S.A. ii./11,347.

Salicyl-sulphonic Acid.

$C_6H_3.SO_3H.OH.COOH=218.138.$

In colourless crystals, prepared by action of sulphuric anhydride on salicylic acid. Soluble in water and alcohol. This test requires careful 'layering' of the urine upon a crystal, or a concentrated solution.

Is an extremely precise, reliable, and quick test, giving a dense white precipitate with all proteins except true Peptone. *Vide* below.

In confirmation note the following:—

Albumin, globulin, myosin, etc., coagulate on heating.

Albumoses dissolve on heating, and reappear on cooling.

Peptones are not precipitated, except in solutions saturated with ammonium sulphate.

Not affected by phosphates, bile, urates or alkaloids.

NOTE.—*Salicyl-sulphonic acid does not precipitate pure Peptone but only the intermediate products between Albumin and Peptone.*

Commercial Peptones, e.g., Witte's, contain considerable quantities of these and so give a positive reaction with Salicyl Sulphonic Acid. We had occasion to purify Witte's make by dissolving in Ammonium Sulphate to check accuracy of the test.

***Endolytic Tubes (Albumin).—**Sealed Capillary tubes partially filled with a solution of this Reagent are portable for clinical use. The ends are snapped off and the urine (if necessary, filtered) is drawn into the tube by capillarity. From opalescence to thick precipitate occurs if positive. Distinguish albumose by pouring hot water over the tube—precipitate dissolves as above detailed. *Acetone, Diacetic Acid and Glucose Endolytic Tubes* are also made.

Trichloroacetic Acid. See Vol. I., p. 27. A saturated solution is used in the same manner as the last test, or a crystal may be used.

May precipitate uric acid and nucleo-proteins.

Tannin-Hydrochloric Acid Test.

Mix 5 Cc. of the specimen with 5 Cc. of 1.5% Alcoholic Tannin Solution warm, and add 5 Cc. of Dilute Hydrochloric Acid (1 in 3). Turbidity or yellowish precipitate. Interfering substances such as urates, phosphates and alkaloids are kept in solution by the acid and resins and alkaloids are redissolved by the alcohol and peptones by heating

Serum Globulin.

Globulin (held in solution by the salts) coagulates by heat and by Acids—readily soluble in an excess of Acetic Acid. The quantity of Globulin is usually extremely small, but in the advanced stage of many cases of Bright's disease, a marked and persistent increase in the proportion of it is a very unfavourable sign.

Roberts' Test for Serum Globulin.

Add the serum drop by drop to a tall cylinder of water. Opalescence is produced, redissolving on addition of a little Acetic Acid or Liquor Potassæ.

To separate Serum Globulin from Serum Albumin—

Faintly alkalise and then saturate with Magnesium Sulphate. Globulin is precipitated whilst the Albumin remains in solution. This may be made quantitative by operating on 100 Cc., collecting precipitate, washing with Magnesium Sulphate, dissolving in weak Saline, adding Acetic Acid (few drops) and boiling to coagulate, collecting, drying and weighing.—Mann.

Globulins. The protein of cerebro-spinal fluid is in the main globulin. In general paralysis the protein is increased, albumin is constantly present. The principal globulin in the fluid in general paralysis is EUGLOBULIN. It is the carrier of the interesting antibody operative in the Wassermann reaction (*q.v.*). Euglobulin differs from Serum Globulin in that it is precipitated in a 33% solution of Ammonium Sulphate, whilst 50% is necessary to precipitate Serum globulin.—L. ii./09,210.

When small quantities only are available, as often in lumbar puncture, add a few drops of cerebro-spinal fluid to the following solution freshly made:—(Spiegler's) Mercuric Chloride 4, Tartaric Acid 2, Glycerin 10, Distilled Water 100. This gives a cloudy precipitate with only traces of Protein; specially sensitive to Serum Globulin.

Albumoses.

To detect Albumoses.—Acidulate the specimen with Acetic Acid, add 10% Potassium Ferrocyanide Solution. This precipitates primary Albumoses. This ferrocyanide precipitation distinguishes albumose from *Compound protein*. On warming the precipitate dissolves, to reappear on cooling. This distinguishes from that due to **Serum Albumin**.

Albumoses dissolve on heating (after precipitation by a reagent, *e.g.*, salicyl-sulphonic acid) and reappear on cooling. What was formerly called '**Peptone**' should really apply to albumose. True peptones (true albuminous substances not precipitated by salting with Ammonium Sulphate) do not occur in the urine.

May safely regard all proteins in urine as albumoses, which dissolve, and reappear on cooling, as above mentioned.—L. i./09,682.

Biuret Reaction.—After testing for albumin in the usual way, with the Nitric Acid ring method, this is removed if present by 10% Trichloroacetic Acid Solution, and the filtrate then tested with the **Biuret Test**. The author employed this as follows:—

In a test tube place 1 drop of Copper Sulphate Solution (2%), add 5 Cc. urine, then 5 Cc. of Sodium Hydroxide Solution (10%). *A rose pink indicates the presence of albumose.*—L. i./09,682.

Albumose, Bence-Jones's occurs in myelopathic albumosuria, a disease associated with morbid conditions of the bones. This albumose is detected by (1) coagulating at 58° C. *i.e.*, lower than serum albumin, which coagulates at 75° C., (2) precipitates with *hydrochloric acid*, (3) nitric acid in the cold—on raising to the boiling point, however, the coagulum dissolves more or less completely and reappears on cooling, (4) with potassium ferrocyanide and citric acid (often takes time to develop, differing in this respect from albumin). The hydrochloric acid test is exceedingly sensitive and does not depend on excess of salts. The result is obtainable after very free dilution of the specimen.

Bence-Jones' Proteinuria.—Note on a case of (chronic nephritis). The urine gave abundant precipitate on applying the ordinary heat test for albumin and rather curdy precipitate at once at well below the boiling point with partial solution on boiling,—completely soluble on addition of a drop of 10%

Acetic Acid. On contact with Nitric Acid in the cold a copious white precipitate formed which disappeared on warming and reappeared on cooling. Ordinary albuminous urine coagulates about 70° C. with no tendency for the coagulum to disappear on raising to the boiling point. In this case however, coagulation began at 52.5° C. and was complete at 58° C. Ordinary Protein tests were +, i.e., Biuret (marked) 'Millon' and tryptophane reactions.—L i./13,522.

Amino-Acids.

Estimation of Amino-Acids in the Urine. P. J. Cammidge estimates the Ammonia present by Folin's method and the Ammonia *plus* Amino Acids present as indicated by Malfatti's process and deducts the first from the second result to give the amount of Amino-Acids present.

Folin's Method consists in aspirating the ammonia formed from 25 Ce. of the urine with about 1 Gm. of Sodium Carbonate through 25 Ce. N/10 Sulphuric Acid containing a few drops of Alizarin Red as indicator, for two hours. The non-neutralised acid is then titrated with N/10 Sodium Hydrate. The difference gives the amount of acid neutralised by the Ammonia in 25 Ce. of the urine—this multiplied by 0.0014 Gm. gives Ammonia Nitrogen.

The **Malfatti process** depends on the fact that Ammonia Salts react with Formaldehyde in neutral solution to form Hexamine, setting free the Acids with which the Ammonia was combined. These can be titrated with alkali.

10 Ce. of urine are diluted with about 50 Ce. of Ammonia-free Water and 3 or 4 drops of Phenolphthalein Solution added. Neutralise with N/10 Sodium Hydrate and note quantity required. 3 Ce. of Neutral Formaldehyde solution are added (pink colour disappears). N/10 Sodium Hydrate is again added to neutralise and the quantity noted. The difference between the first and second readings multiplied by 0.0014 Gm. and the result by 10 gives the percentage of 'Ammonia' Nitrogen. From this the content of 24 hours urine is calculated. Amino-acids react like Ammonia to Formaldehyde so that the result by the Malfatti process is the sum of Ammonia plus Amino-Acids present as already stated.

The amount of Amino-Acid Nitrogen in simple cases of glycosuria may be nil by the method described, except where there is evidence of a gouty condition or serious hepatic derangement, then there may be 0.5 Gm. in 24 hours. When secondary disturbances of metabolism occur the Amino-Acid Nitrogen is small at first, 0.05 Gm. or less. It generally increases rapidly, often more so than Acetone, until 2 Gm. or more is being eliminated. Finally it may be present in such amount that Tyrosine crystallises out.

The appearance of Amino Acids in the urine in diabetes is usually a sign that more Carbohydrate is being consumed than the patient can deal with efficiently. Careful dieting to reduce it will effect prolongation of life.—P. J. Cammidge, L. ii./13,1319.

Histidine $C_6H_9N_3O_2$ is one of a series of bases termed protamines. They occur in the spermatozoa of fish. They give the Biuret reaction. Histidine is frequently found as a decomposition product of Albuminoid bodies. Pyman has synthesised it.—P.J. i. 16,108.

Abderhalden's Serum Reaction.

Abderhalden demonstrated the capacity of the Blood Serum during pregnancy to break down placental albumins and peptones.

It has been shown that similar reactions are obtained with blood serum from females suffering from genital growths, also that albumins from placenta, uterus, ovaries, genital neoplasms and to a less degree muscles are similarly broken down—the reaction being general rather than specific.—B.M.J. ii./13,183.

Ninhydrin.—Triketohydrindene Hydrate for Abderhalden Serum Reaction.

When heated to boiling in aqueous solution (1%) in presence of Protein bodies or certain Amino-Acids this body gives a bluish violet colour. Hence used as a test for Albumin, Peptone, Polypeptides and Amino-Acids. Especially to demonstrate in Blood Serum presence of specific proteolytic ferments, in particular in diagnosis of normal pregnancy. In cases of carcinoma and fever the reaction may be doubtful.—Jl. A.M.A., 1912,1377; B.M.J. ii./13,1004.

Technique of the Reaction.—W. E. Bullock, L. ii./14,225.

Negative results with the reaction as a test for Amino-Acids in serum of nephritics and others. A few tests were made with ascitic fluid with negative results.—R. M. Pearce, J.A.M.A., 1913,1456.

Abderhalden's method in diagnosis of carcinoma. A paper demonstrating the possibility of the existence of a specific ferment against carcinomatous tissue in diagnosis of carcinoma. The blood of persons suffering from carcinoma contains a substance absent in the blood of all others having a proteolytic action on carcinoma tissue only. Several factors point to it being of ferment nature.—L. ii./13,1385. See also L. i./14,1411.

In cancer diagnostic value of the reaction is to say the least doubtful.—B.M.J.E. ii./15,36.

For detecting the products of ferment action are employed (1) the altered rotation of the plane of polarisation, resulting when the serum acts on a solution of peptone derived from the tissue in question, and (2) the demonstration of diffusible products by means of Ruhemann's reagent as above.

According to Browning, the differences in rotation are generally small and the line of demarcation in the Ninhydrin reaction is not adequate.—B.M.J. i./15,239.

A table giving results in some 120 cases shows that the results do not confirm the possibility of demonstrating specific ferments, but in admiration of Abderhalden's theoretic views.—J. O. Gavronsky, L. i./15,119.

Placentin as cuti-reaction in pregnancy.—B.M.J. i./14,833. *c.f.* Animal Organotherapy, p. 158.

Bile.

(With some notes on further abnormal constituents.)

Nitric Acid (Sp. Gr. 1.420 is best, W.H.M.) *i.e.*, **Gmelin's Test** produces a bluish-green ring and play of colours.

A moderately icteric urine diluted even 1 in 50 will give this usually.—W.H.M. on application of.—C.D. i./03,171.

Peptone Test.—Peptone, in powder 30, Salicylic Acid 4, Acetic Acid 30, Distilled Water 3,500.

Dissolve and filter. Add 1 of urine containing bile salts to 3 of this solution opalescence (or p.p.) appears; it dissolves completely on adding acetic or citric acid, and diminishes, but does not disappear on boiling.—*Oliver*.

Tincture of Iodine.—A few drops "layered" on to the specimen and the tube shaken gently, produce a green colour if bile pigment be present.

Pettenkofer's Test for Bile Salts. Add a few drops of Syrup, shake, and then Sulphuric Acid.—Reddish-violet colour. *c.f.* **Acid Cholic** and **Sodii Taurocholas** in **Organic Analysis Chart**.

Chromic Acid. 5% solution added gradually produces a green colour.

Sodium Nitrite with Sulphuric Acid (Vitali's Reaction) gives green colour.

The spectroscope is employed for detecting **Urochrome, Urobilin, Hæmatoporphyrin, Uroerythrin.**

Urine of patients taking Iridon, Tetronal and Sulphonal should be watched for possible hæmatoporphyrinuria.

An account of a case exhibiting.—L. ii./12,960.

Hæmatoporphyrinuria does not alone account for the altered color of the urine.—L. i./09,1106.

Urobilin.

Simple test for (Schlesinger). To the unfiltered urine add alcoholic solution of Zinc Acetate 1 in 10. Shake and add a few drops Lugol's Solution. Fluorescence in varying intensity indicates presence. Has been used as a test for Malaria, *q.v.*

Urobilinogen. This body is stated to be the parent of Urobilin (*v. above*). Urobilin is formed from it on standing exposed to the atmosphere.

UROBILINOGEN TEST (P.G.V.):—Dimethylparaminobenzaldehyde $C_6H_4N(CH_3)_2.CO.H$ (1:4) M. Pt. $73^{\circ} C.$ 2, dissolved in 98 of a mixture of Hydrochloric Acid 4 and Water 1. (*c.f.*, Ehrlich's Indican Test.) It will be seen that the parent substances of Indican *viz.* Indol C_8H_7N and Indoxyl $C_8H_5(NH)OH$ bear relation chemically with the bodies contained in Urobilinogen *viz.*, Bilirubin $C_{32}H_{36}N_4O_6$, Hydrobilirubin $C_{32}H_{40}N_4O_7$, etc.

Diagnosis of commoner cases of chronic jaundice. Examination of the urine should be as complete as possible, *e.g.*, test for bile (Gmelin's test is best), for Urobilin (by Alcoholic Zinc Acetate Test), Indican, Sugar ("the presence of this in a case of chronic jaundice is almost pathognomonic of serious disease of the pancreas which may be malignant or inflammatory.") Glycosuria was met with by the author of this paper in 7.5% cases under his care,—(it occurs with almost the same frequency in cancer of the pancreas and in jaundice due to gall-stones,—8% and 9% respectively). Conduct the "pancreatic reaction" (positive reaction obtained in 64% of cases of chronic jaundice), examine for fats, intestinal putrefaction, color, etc.—P. J. Cammidge, B.M.J. i./11,486.

Cholesterin (*q.v.*) is rarely found. It is usually derived from a collection of pus that has been retained in a cavity for some time, ultimately discharging into the urine. A few recorded cases are detailed.

To separate cholesterin extract the specimen with alcohol-free Ether. Purify the residue on evaporation by dissolving in strong alcoholic potash, evaporating, extracting again with Ether, and this again with boiling alcohol—rhombic plates.—Mann.

Chloroformic solution of Cholesterin with Sulphuric Acid gives a red to purple colour. An Alcoholic solution so treated gives red to blue.

Cholesterin crystals are found in the urine, in diabetes, in cystitis, Bright's disease, pyonephrosis, epilepsy, in tabes and lipuria, and in fatty degeneration of the kidneys.

Tyrosin, β -Oxyphenylalanin- α .

$C_6H_4.OH.C_2H_3(NH_2).COOH = 181.143.$

Is recognised by its characteristic crystalline appearance being in shining needles, either in bundles or star form.

Russula delica.—The juice of this fungus is a test for Tyrosin; changes it from red to black. The fungus has stem short 1 to 2 ins. high, $\frac{1}{2}$ in. or more thick, even, smooth white cap, fleshy, 3 to 5 ins. broad, funnel-shaped when full grown, regular, even, smooth, margin involute, without striæ, flesh firm, dry, white.

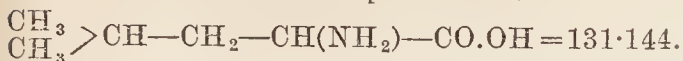
Further Tests for Tyrosin:—

Two Cc. of Sulphuric Acid mixed with 3 to 5 drops of a Solution of Aldehyde in twice its volume of Alcohol 90%, care being taken that the liquid remains colourless—a few drops added to the suspected liquid produces a gooseberry red colour. This test is supposed to detect Tyrosin up to 1 in 10,000.

Piria states on adding a few drops of strong Sulphuric Acid to a little Tyrosin in a dish it dissolves with slight reddening, on saturating with Barium Carbonate (after diluting) and adding to the filtrate neutral Ferric Chloride Solution a violet colour is formed.—Schmidt.

Ammonium-Sulpho-Molybdate *q.v.*, gives blue to violet colour.

Leucin α -Amido iso-caproic Acid.



Leucin occurs as an early result of protein cleavage. There are two isomeric forms of it—respectively *lævo*- and *dextro*-.

Is in crystalline spheroidal clumps. An arterial depressor. Has been given in arteriosclerosis.

Occurrence and significance in the urine.—R. W. Allen, B.M.J. ii./19, 238.

Blood Corpuscles

may be recognised microscopically. The red blood corpuscle has an average diameter $7.5 \mu = \frac{1}{33.33}$ inch. It is discoid in shape with indentations in the two sides. Occasionally it is smaller, *e.g.*, 6μ ($= \frac{1}{42.00}$ inch). Price-Jones determined in normal human blood diameter to be 6μ to 8.75μ —with an average of 7.4μ , whilst in pernicious anæmia the diameter varied from 4μ to 11.75μ , and the average diameter of five successive 100 cells was 8.0μ .—B.M.J. ii./10, 1418.

In disease it may reach 8 to $10 \mu = \frac{1}{31.75}$ to $\frac{1}{25.40}$ inch, *i.e.*, ANISOCYTOSIS, or irregularity in size; further in disease the corpuscles may exhibit POIKILOCYTOSIS, *i.e.*, irregularity in shape. In examination of films VACUOLATION should be noticed, as also irregularity in staining (POLYCHROMATOPHILIA). With regard to abnormal red cells—these are mainly of two kinds, (1) those like normal cells without nuclei, (2) nucleated. The group (1) where they have special designations have names ending in *cyte* (*microcyte*, *megalocyte*, etc., based on the type of the normal corpuscle which is called *erythrocyte*), whilst the nucleated forms have names ending in *blast*. In this group are *normoblasts*, *megaloblasts*. For morphological details and significance special Text Books on Haematology should be consulted.

The Structure of the Red Blood Corpuscle.

“It would seem that there is some outer structureless material on a red corpuscle that is removed by strongly acid pepsin solutions. Inside this lies the true envelope of the red cell, devoid of histological structure, capable of coalescing with similar material in other red cells to form a bigger mass, and capable of fractionation into smaller masses. Within this again is the hæmoglobin, not in watery solution, perhaps linked to the envelope by lecithin. And within the capsule of envelope and hæmoglobin lies the material that is extruded to form the blood platelets, perhaps also the bodies which exhibit Brownian movements in fresh preparations of living blood and the so-called ‘spirochaetes’ of normal blood.”—E. M. Brockbank.—B.M.J. ii./13, 1104.

For details of **white corpuscles** *v. p.* 382.

Precipitin Test for Blood.—Precipitins are formed when the serum of one kind of animal is introduced into the body of another species. *e.g.*, the serum of a horse injected into a goat causes the serum of the goat to be capable of forming a precipitate with normal horse serum.

In using the test for forensic purposes a rabbit is injected with defibrinated human blood. The serum of the rabbit ‘**anti-human serum**’ when dropped into a clear solution of human blood causes a precipitate,—not in solution of blood from another animal. The principal difficulty in the test is to obtain from the rabbit an antihuman precipitating serum of the proper strength. To be thoroughly reliable and specific *the formation of the precipitate must begin in five minutes and be complete in thirty minutes*. Old blood stains respond as well as recent. It has been stated that the blood of mummies, 3,000-5,000 years old could be identified as human by the method.—L. i./11, 319.

Examining mosquitos which had been in contact with certain animals it was possible to determine with accuracy the species of the animal each mosquito had bitten and to prove absence of human blood.—B.M.J. i./10,85.

The test was employed in the Clapham murder case. A human blood stain taken up with normal Saline and some anti-human Serum added causes a white cloudy ring,—not so the stains from animal blood. Specific sera injected into a rabbit form an equally specific anti-serum—in other words, human anti-serum, will infallibly detect human blood,—a horse anti-serum will detect horse's blood and so on.—P.J. i./11,202.

INTERPRETATION OF THE REACTION.—An investigation dealing with the weights of the precipitates,—the main mass of the precipitate appears to be composed of anti-substance (Precipitin).—B.M.J. ii./10,1511.

Indian experience with the test was that it is absolutely trustworthy,—the reaction is not effected by the decomposition of the blood, by heat, etc. Fowl's blood used instead of rabbit's. Failures with goat's and monkey's blood.—B.M.J. i./11,1481.

Hydatid Fluid may be used to give precipitin test as aid in diagnosis. Interaction between hydatid fluid and serum from hydatid patients has been obtained.

In the rarer cases where the echinococcus has invaded bone structures diagnosis is difficult. The hydatid fluid must be fresh for the test. The presence of eosinophilia is a useful help to diagnosis.—B.M.J. ii./09,957.

Hydatid disease. Complement-fixation as mode of diagnosis. Found to be of considerable value in the few cases available,—positive results are conclusive, negative difficult to interpret. Modified Hecht method used. The alcoholic heart muscle being replaced by Hydatid Fluid of the sheep as antigen. Hitherto the method of diagnosis has been the verification of eosinophilia,—this is, however, characteristic of almost every form of vermiform parasite.—L. ii./10,377.

Blood in Urine.—To test for, heat the specimen with strong potash or soda. If present a colour described as bottle-green is produced, and earthy phosphates coloured brownish-red by blood are precipitated.

Ozonic Ether and Guaiacum Test for,—add a drop or two of Tincture of Guaiacum—Guaiacum Resin 1, in Alcohol (90%) *q s.* to 10—to a small quantity of the urine, shake and 'layer' Ozonic Ether on to the mixture. A blue colour at once, or on standing, indicates presence of blood—Iodine in the urine also gives this colour (*e.g.* if patient has been treated with iodides). Further, pus gives it with Guaiacum Tincture alone, the colour disappearing on heating.

Modified Guaiacum Test using Sodium Perborate.

To about 5 Cc. of the liquid add 1 to 5 drops of Alcoholic Solution of Guaiacum Resin (saturated in the cold, and not more than 12 hours old), then about 1 Gm. Sodium Perborate and about 10 Cc. of 30% Acetic Acid, shake the mixture once and pour Alcohol carefully into the tube to form a separate layer,—a blue or blue-green color at the junction in five minutes will be formed, or green if only a trace. The test is said to show 0.035 Gm. of blood in a litre of water. The Guaiacum resin used must show a brown, not a greenish fractured surface.—P.J. ii./10,365.

In our laboratory we found this to indicate 0.02 Gm. of blood per litre, i.e., 1 in 50,000. It is about five times as delicate as the Ozonic Ether Test. A green colour should be disregarded as we found a blank test gives a green. Fresh Solution of Guaiacum had no advantage over seven months old Simple Tincture of Guaiacum.

Benzidine.—Saturated Alcoholic Solution—a few drops added—shaken and 'layered' with Ozonic Ether forms blue ring at once. *Vide* also below.

Blood, Recognition of, in Stains.—Plunge the cloth into boiling water for a few minutes, place on slide and add few drops of Ammonium Sulphide. Examine microspectroscopically for absorption bands of hæmochromogen. May be increased by 10% Potassium Cyanide Solution. If on a weapon or piece of jewellery, moisten with Ammonium Sulphide and scrape off sufficient and examine as before.—B.M.J. ii./00,1261.

Oxyhæmoglobin in solution with a little Sodium Chloride evaporated over Sulphuric Acid to syrup consistence. Mixed with fifteen times volume of Glacial Acetic Acid and heated on a water bath several hours yields, on cooling, flat rhombic crystals of Hæmatin Hydrochloride with dark violet colour and lustre—this is one of the recognised tests for blood stains.—B.P.C.

Blood Stains on Clothing, etc.—The Guaiacum Test is highly spoken of. The stain must give a red aqueous extract yielding no coloration to a straw-coloured solution of Guaiacum in alcohol 90% when applied by itself but a blue colouration within one second on further addition of Hydrogen Peroxide. Oxidisers and enzymes give a reaction with Guaiacum Solution *alone*. Blood does not.—Analyst, 1912; Y.B.P., 1913, 40.

Recognition of Blood Stains.—Chloral Solution to extract blood stains. The stain is moistened with Acetic Acid and then soaked in a 70 to 80 per cent. solution of Chloral Hydrate for one or several hours if necessary. To the solution add a few drops of the Reagent (Guaiacum, Barbaloin, or Benzdine), then add Hydrogen Peroxide 10 volume strength diluted with double volume of Alcohol and slightly acidified with Acetic Acid (carefully superposed). The presence of Pyridine greatly accelerates and intensifies the reactions.—P.J. ii./12, 158.

Benzidine Test for Blood in Urine and Pathological Material.

Benzidine. *Syn.* *p*-Diamidodiphenyl.— $\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{C}_6\text{H}_4\cdot\text{NH}_2=184\cdot176$
Grey crystalline powder soluble in alcohol, is used as blood test.

Employ a 1% solution in 90% alcohol or 1% solution in a mixture of equal parts Glacial Acetic Acid and water. Whichever is used the result is practically identical. There is merely a difference in the shade of blue produced in the presence of blood.

To apply the test add to 2 Cc. of the Benzidine solution about the same quantity of 20 volume Hydrogen Peroxide. Mix and add 2 Cc. of the liquid to be tested. A blue colour forms at once if blood is present. The density of the colour corresponds to the amount of blood. Always conduct a control with normal material alongside.

Alternatively, mix 2 Cc. of the specimen with a few drops Benzidine solution and layer carefully with ozonic ether. In this case a blue ring is formed.

By the above test we found that 1 of blood in 1000 of liquid is easily detected.

—indeed, we have been able to detect a far smaller amount—even 1 in 100,000.

Diastases, Zymases, Fruit Juices give similar reaction. A positive reaction does not prove blood, but the negative proves its absence.—P.J. ii./10, 298, 492.

Tablets of Benzidine 0.1 Gm. and Sodium Perborate 0.1 Gm.

Just before use dissolve a Tablet in 10 Cc. Glacial Acetic Acid. If a suspected spot on an article of clothing, etc., is to be examined, it is moistened with a drop of Normal Saline and well rubbed with a glass rod. The drop is then absorbed in a small piece of absorbent cotton wool and the spot at once treated with a few drops of the Reagent. In presence of blood a blue color is seen.—J.C.S.A. ii./10, 665.

Blood and Soluble 'Albumin' in the Stools:—

Mayer's Phenolphthalin Reagent has been used for the first mentioned:—

Phenolphthalein 2 Gm., Potassium Hydroxide 20 Gm., water 100 Cc. Dissolve and add Zinc 10 Gm. and boil. Filter while hot (and decolorised). Keep in the dark with a little Zinc at the bottom.

In using, a small piece of faeces is taken from the middle of the stool after a *milk* diet and made into fine suspension by adding water if necessary. Fill a test-tube about one-third full with this. Add one-third of its volume glacial acetic acid, mix and boil and cool under tap. Add 5 Cc. Ether, mix well and set aside. Pipette off and add 1 Cc. of the reagent and a few drops of Hydrogen Peroxide. If blood present *immediate* deep red colour spreading down the tube.

Weber's Guaiacum Test. Make Ether extract as above and add 8 to 10 drops Guaiacum Tincture and Hydrogen Peroxide. Definite blue colour in 2 minutes. For albumin add equal volume of saturated solution of Ammonium Sulphate, filter, acidify and warm.—R. Coope, L. ii./20, 291.

Benzidine Test is very sensitive and simple.—A. Abrahams, L. ii./20, 420.

Thymolphthalein as Blood Test.

Dissolve Thymolphthalein 1 in water 100 and add Potassium Hydroxide 25 and Zinc Powder 10. Boil until colorless, filter hot and make up to original volume. Keep Zinc filings in the solution to prevent oxidation.

To use the test, rub down a small portion of the faeces (*e.g.* size of a bean) with 5 to 10 Cc. of Alcohol and 20 drops of Glacial Acetic Acid. 25 to 30 drops of the Extract are filtered off and 20 drops of the reagent added mixed.

with 15 drops of Hydrogen Peroxide. On shaking a greyish-blue opaque precipitate forms turning blue on standing if blood is present.—Y.B.P. 1919, p. 46.

See also **Fæces**,

Choline.—**Haliburton and Rosenheim's Test for in the Blood and Cerebro-spinal Fluid.**—Dark brown crystals (Choline Periodide) resembling hæmin appear on adding a strong solution of Iodine in Potassium Iodide to Choline-platino-chloride crystals. To prepare the Platino Chloride of Choline is, however, not essential, as the test can be applied direct to the Alcoholic Extract of the fluid

The **Marchi Reaction** for showing nerve degeneration consists in the fact that the fatty acid (decomposition product of Lecithin) stains black with Osmic Acid even in the presence of Chromic Salts which Lecithin does not.

The products of degenerative nerve disease, notably Choline can be detected in the blood and cerebro-spinal fluid.

Hæmoglobin Estimation.—Sir Wm. R. Gowers' apparatus consists of two tubes, flattened or round, one closed, containing glycerin jelly coloured with picro-carmin—the standard equal to the colour of a dilution of average normal blood one hundred times (20 cmm. in 2 Cc., and the other, graduated in 100 degrees=2 Cc. for the dilution of the sample of blood with distilled water. The outfit further includes a pipette, pricker, india-rubber stand, &c.

The lobe of the ear or the finger is pricked and 20 cmm. of blood are drawn up into the pipette, injected into the graduated tube, which should at the time contain a few drops of water to prevent possible coagulation and facilitate mixture. Water is then added sufficient to produce a tint the same as the standard, the two being frequently compared during the process. The degrees of dilution needed indicate the percentage amount of hæmoglobin. For example, 20 cmm. of blood from an anæmic patient giving the standard tint at 30 degrees of dilution would contain only 30% of the normal quantity of hæmoglobin

Haldane's Modification of Sir W. Gowers' Hæmoglobinometer is now extensively used where coal gas is available. The standard tint tube is a 1% solution of blood containing the average percentage of hæmoglobin found in the blood of healthy adult men, and having an oxygen capacity of 18.5% as determined by the ferricyanide method. *The solution is saturated with carbon monoxide*, and hermetically sealed. It is both definite and permanent. The graduated tube holds 2 Cc. when filled so that the inside is completely wetted and the liquid stands at the mark 100 after half a minute has been allowed for the upper part to drain. The tube is graduated in percentages of 2 Cc.

A cap for attachment to a gas-burner serves to deliver gas for saturating the diluted blood with CO.

The advantages of the modifications are: (1) that the standard solution is a definite one, so that an instrument can be verified at any time by making a determination with ox-blood of which the oxygen capacity has been determined by the ferricyanide method; (2) that the standard solution is permanent; (3) that the apparatus can be used with equal correctness by daylight and artificial light

As coal-gas is not always available in examining the blood of patients the instrument can always be supplied with an additional standard tube containing picro-carmin jelly, as in the original Gowers' Hæmoglobinometer. The picro-carmin jelly is standardised to correspond with blood of 18.5% oxygen capacity, but is liable to slow alteration on keeping. Its value in terms of the sealed tube of blood solution should therefore be occasionally ascertained by determining the hæmoglobin in blood from the same person, first by the picro-carmin standard and afterwards by the sealed blood standard. The difference gives the percentage correction needed for the picro-carmin standard. The picro-carmin standard tube should be kept in the box, and not exposed unnecessarily to light

Other Hæmoglobinometers are **Oliver's**, **Fleischl's** and **Sahli's Hæmometer**.

Taliquist's Hæmoglobin Scale consists of a scale of colours with strips of blotting paper to suck up the blood for examination. The tint thus produced is compared by direct light with the scale. The scale indicates 10, 20, 30, &c., up to 100. This refers to amount of hæmoglobin—100 being taken as normal.

Corpuscles Estimation.—One cubic millimeter contains normally about 5,000,000 to 6,000,000 red corpuscles in man, and about 4,500,000 in woman. The average number of white corpuscles per cubic millimeter is about 7,000 to 8,000 in adults, and 10,000 in children.

The hæmacytometers chiefly employed are Gowers' modification of Hayem's, and that of Thoma-Zeiss.

In the **Gowers Instrument** the cell is $\frac{1}{2}$ mm deep, and each side of a square is $\frac{1}{10}$ mm., hence the volume of the small square is $\frac{1}{500}$ cmm. This instrument contains, in addition to the cell, a small pipette which, when filled to the mark on its stem, holds exactly 1.995 cmm., a capillary tube marked to contain exactly 5 cmm., a glass stirrer, a lancet, needle, &c. The dilution employed is 1 to 200. The number of corpuscles in 10 squares is counted, and this multiplied by 10,000 gives the number in a cubic millimeter. The above dilution and squares are so arranged that normal blood presents 50 corpuscles per square, or 100 in 2 squares; and by counting 10 squares so as to get the average for two, the *percentage* of corpuscles to that of health is evident, and may be compared with the percentage of hæmoglobin as ascertained by Sir Wm. R. Gowers' hæmoglobinometer *q.v.*

If, for instance, the blood contain 80% of corpuscles and only 40% hæmoglobin, the value of each corpuscle is represented by the fraction $\frac{1}{2}$. Sometimes in pernicious anæmia the corpuscles sink below the amount of hæmoglobin, and there may be 30% of corpuscles and 40% of hæmoglobin, in which case the value of the corpuscle is $\frac{3}{4}$. The corpuscles having settled, and the percentage ascertained, the objective may be raised so that the corpuscles are somewhat out of focus, the **leucocytes** then appear as bright points, in consequence of their greater refraction, and their number may be counted. Sir Wm. R. Gowers prefers this method, to that of staining.

The **Thoma-Zeiss** instrument consists of micrometer slide divided into 16 squares, each square again divided into 16 smaller squares. It has two pipettes, one for diluting the blood 1 to 100 and 1 to 200 for counting the red corpuscles, the other is intended for estimation of the leucocytes, and dilutes the blood 10 or 20 times. The number of red corpuscles seen in 4, 6, or if greater accuracy is required, 16 (larger) squares, *i.e.*, in 64, 96 or 256 smaller squares, is counted. To ascertain the **Number of Red Corpuscles** in 1 cmm. of blood, knowing the volume of the cube standing on each small square to be $\frac{1}{4000}$ cmm., *multiply the total number of red corpuscles counted by 4,000 times the number of times of dilution of the blood and divide the result by the number of small squares in which red corpuscles have been counted.* It is always desirable to have an assistant to note the numbers observed, and to count the corpuscles touching and overlapping the two adjacent boundary lines on the left upper corners of the squares, but those on or overlapping the other two sides are excluded to compensate.

The normal dilution is 1 to 200; in polyemia 1 to 400; and in excessive anæmia 1 to 100 may be used. 5 or 6 corpuscles per square are a convenient number for counting.

The Thoma-Zeiss cell is $\frac{1}{10}$ mm. deep and each side of a small square is $\frac{1}{20}$ mm., hence the above figure $\frac{1}{4000}$ cmm. as the volume of a small square.

Gowers' Hæmacytometer Solution is used for diluting in both the above instruments.—Sodium Sulphate 104 grains, Acetic Acid 1 drachm, Distilled Water 4 ounces. Filter.

Hayem's Solution is also employed. Sodium Chloride 2, Sodium Sulphate 5, Mercuric Perchloride 0.5, Water 200.

Edington's Hæmacytometer Solution.—Sodium Citrate (neutral) 7.5 Gm. Formalin (40% Commercial), 2.0 Cc. Dahlia (Methyl Violet), 0.03 Gm. Chloroform 5 drops, Distilled Water 250 Cc. Mix the stain with the water, then add the Sodium Citrate and the Formalin. Has the advantage that in less than 1 minute, all the corpuscles are deposited on the slide and in focus. The refractive index of the corpuscles is well maintained.—L. ii./07,86.

The **Ehrlich Blenden Eyepiece** is stated to simplify counting either red or white corpuscles. It consists of an ordinary No. 2 eyepiece with a screen which cuts out a square from the field of vision. The number of corpuscles seen per square (average of several counts) $\times 4000 \times$ the dilution (1 in 100 or 1 in 200) gives the number per cubic mm.—L. ii./09,1424.

Estimation of Red Corpuscles by means of the **Hæmatocrite** (not satisfactory for the white). This instrument consists of two graduated capillary tubes in a metal frame for inserting in a centrifuge to be revolved at high speed.

Make a mark on the draw-tube—to be used for all occasions. Count twenty fields with above dilution, and add two cyphers to the number so obtained.—B.M.J. i./05, 410, 576, 696, 914, 1132.

A further simple method of counting.

Draw up measured quantity of blood with capillary tube and pipette, and in the same manner ten times as much water, mix on watch glass. Drops (all the same size of the mixture are arranged on a slide (*s.a.*) in line. Dry slowly in the sun or before a fire, then gently agitate in a dish of water until all pigment is washed off. Examined under the microscope each spot will be seen to consist of a faint amount of debris with dark conspicuous leucocytes. They may be stained with Methylene Blue if preferred. Count the cells in several fields, using $\frac{1}{8}$ in. objective, a stiff paper obturator (pierced with ranks of 20 or more holes made by a large needle—each, on an average with normal blood, to show 2 or 3 leucocytes per hole) is fitted in the eyepiece. If 10 films be searched thus, a good average will be obtained. Two to four fields, each from a different film, is sufficient to count as a rule. The average number per field for normal persons is noted—*i.e.*, 8,000 per cmm. A simple comparison indicates degree of leucocytosis.—B.M.J. ii./09, 1749. See also L ii/08, 1746.

Total and Differential Leucocyte Count conducted simultaneously.

Diluent employed is a mixture of Wright's Modification of Leishman's Stain 4, Acetone 3, Methyl Alcohol 1, Water 12. This is used freshly made up and filtered in any dilution from 1 in 200 to 1 in 10. The white cells stain as in a film, whilst the red are colourless. A dilution 1 in 100 gives about 80 cells on the large square of a Thoma-Zappert Slide which is enough for the total count, whilst 300 elsewhere can be found for the differential. In marked leucopenia, a 1 in 10 dilution gives as many cells as required in a few minutes. In many cases a glance gives the result, *e.g.*, a marked eosinophilia, or excess of lymphocytes, large mononuclears or polymorphic cells. The stain is mixed with the blood in a small tube, *e.g.* a Haldane Hæmoglobinometer tube cut down to the 120 mark. With this, 24 divisions of water and the rest in proportion are sufficient for a 1 in 100 pipette if it can reach to the bottom.—L. i./12, 20.

Note.—All tinting solutions should be freshly prepared as precipitates interfere with accurate counting.

The method was found unsatisfactory in hot weather. The following was preferable.—make a $\frac{2}{3}$ saturated solution of Wright's Stain in Methyl Alcohol by adding 5 Cc. of Methyl Alcohol to 10 Cc. of Saturated Solution. Add 1 part of this to 3 of Saline, 0.1% strength. Stains well without precipitating on the slide.—L. ii./12, 1179.

A Blood count in a case of medullary leukæmia showing improvement under Arsenic and Iron.

Red Corpuscles	..	..	3,600,000	after 9 days	4,840,000
Hæmoglobin %	..	..	30	..	45
Color Index	..	..	0.4	..	0.8
Total White Cells	..	..	77,700	..	42,000
Polymorph. Neutrophiles	..	..	50.7	..	46
Large Lymphocytes	..	..	11.2	..	12.5
Small Lymphocytes	..	..	2.3	..	1.5
Hyaline Lymphocytes	..	..	0.5	..	0.5
Transitional	..	..	0.7	..	9.5
Basophiles	..	..	5.5	..	—
Eosinophiles	..	..	0.3	..	4.0
Myelocytes:—					
Neutrophile..	..	..	17.0	..	—
Basophile ..	..	..	11.0	..	26.0
Eosinophile ..	..	..	0.6	..	—
Mixed ..	..	..	0.2	..	—

MYELOGENOUS LEUKÆMIA in an infant of 18 months:—

Red Corpuscles 4,080,000 per Cmm., White Corpuscles 63,400, Hæmoglobin 80%. Polymorphonuclears 32.4%, Lymphocytes 5.2%, Large Mononuclears 18.8%, Transitional 12.8%, Eosinophiles 2.8%, Basophiles 0.6%, Myelocytes—Neutrophile 25.8% and Eosinophile 1.6%, Normoblasts 1.6 per 100 leucocytes. The proportion of myelocytes is not so great as is found in cases of this disease in adults. The number of large mononuclears is excessive. It is possible these large mononuclear cells are the precursors of myelocytes

i.e., myelocytes before they have taken on a fine granulation. Myelogenous leukaemia at such an early age is distinctly rare.—P.R.S.M. Diseases of Children, Sect., March 1910, p. 92.

For details of average (adult) spleno-medullary leucocythæmia blood count see Emery.

The TOTAL SOLIDS OF LEUCOCYTES to extent of 68% consist of Nuclein with 3.01% of Phosphorus. Frick found in the blood of four tuberculous patients an average of 0.291 of Phosphorus, the maximum being 0.351 and the minimum 0.197, whereas in normal blood he found 0.874 parts per 1,000—illustrating deficiency of Phosphorus in tuberculous blood.

On the Value of Blood Examination to the General Practitioner. Value of Blood Examination in treatment of chlorosis. Fallacy of giving more iron in one week than the body contains under ordinary circumstances. Chlorosis will improve and recover without any iron at all. In chlorosis the total amount of hæmoglobin is normal even though the readings by the hæmoglobinometer may give figures below normal. A given unit of blood removed from a patient suffering from chlorosis contains less hæmoglobin than the same volume in health—this is due to the fact that in chlorosis the blood plasma is increased in quantity, and there is therefore less room in the particular volume of chlorotic blood for the number of corpuscles usually existant. Though the number of red corpuscles may by a count show as low as 3,222,000, the absolute number of same is really much greater even by as much as three times or more. Therefore, as the total amount of hæmoglobin is normal in chlorosis, each red corpuscle will contain less hæmoglobin than normally.—The investigations of Lorrain Smith.—Batty Shaw; B.M.J. i./07,973.

Blood examinations in 30 cases of rickets showed that only nine presented anæmia, in not one of which was the number of red cells less than 4,100,000 per cmm. In 19 there was a slight increase in the number of white cells.—B.M.J. i./09,1177.

Cases illustrating the value of an examination of the blood—by blood counts, estimation of hæmoglobin and Serum Tests.—E. H. Shaw, L. ii./12, 286.

Leucocyte count valuable as a guide in treatment of war wounds.—B.M.J. i./17,465.

Volume of Blood.—Method of estimating. The principle employed was to inject into the blood stream a known amount of hæmoglobin, and then determine degree of resulting hæmoglobinæmia.—B.M.J. i./09,1357.

In **PERNICIOUS ANÆMIA** the red corpuscles, instead of 5,000,000 or more per cmm. are only 2,000,000 or even as low as 1,000,000. Hæmoglobin is also reduced, but not to an equal extent. *A very useful account of the microscopy of the blood in this condition.*—B.M.J. i./09,1348

Hæmolytic Action of Urine in cases of pernicious anæmia. Incubation at 37° C. of the blood emulsion with the specimen of the urine effects laking, but this does not occur with the urine in health. It also occurs in other disturbances of metabolism, and is not diagnostic or prognostic of pernicious anæmia. Sodium Bicarbonate influences the reaction *in vitro* and possibly when given to patients *per os*.—C. S. Mackie, B.M.J. ii./15,596.

Arneth Index.—The number of the lobes of nuclei in neutrophile leucocytes although constant in health is altered in infectious diseases. (Arneth Deut. Med. Woch. 1904, i. 54), divided neutrophile leucocytes into five classes according to the number of nuclei contained, and further divided these five classes into three, four or more subclasses dependent on the shape of the nuclei. Class I. and II. are the most important—those comprising one or two subdivisions of the nucleus. The Index is the sum of these two found in counting 100 such cells. There is a well marked increase of Classes I. and II. in infectious diseases which he called a shift to the left. In pulmonary tuberculosis (1) the shift to the left is in proportion to the extent of the disease; (2) as the patient improves

the index moves more to the normal ; (3) unless the index is normal no case can be regarded as really cured. Experimental work in part confirmation. Bibliography.—H. A. Treadgold, L. i./20, 699, 920.

Blood Staining.

To make films, prick patient's finger, press, let first drop of blood fall away, place the next drop (small) on the centre of a *really clean* $\frac{7}{8}$ in. square cover slip. Superpose another and pull off so that the film is thin and even—not 'ridges' and 'valleys' and dry in the air. No fixing is necessary,—the Methyl Alcohol in the stain (Leishman, etc.) does this.

Jenner's Stain is used. It may be prepared by mixing freshly 100 Cc. 0.5% Solution of Medicinal Methylene Blue in Absolute Methylic Alcohol with 125 Cc. of a 0.5 Solution of Eosin (water soluble yellow shade). Filter. A similar stain is produced by dissolving the precipitation compound—(Eosin-Blue) in Methyl Alcohol.—*c.f.* Lieshman's Stain.

Method of use.—Add $\frac{1}{5}$ volume of Distilled Water to the Stain when on the film (*e.g.* 1 drop to 5 drops), and rock gently. Stain for five minutes, then wash in distilled water until pink tint replaces greenish colour. Remove excess of water by filter paper and dry in the air without heating.

Should be kept in stoppered bottles well closed, and is best recently prepared. The Methylene Blue and Eosin are said to combine, forming a chemical compound. In staining it is important to cover with a watch glass to prevent evaporation of the Methyl Alcohol.

Jenner's Stain is, *we found, improved by using Polychrome Methylene Blue* in place of ordinary Methylene Blue. The 'polychromatising' we effected by adding finely powdered crystalline Sodium Carbonate to the Methylene Blue Solution in the proportion of 1 Gm. of Sodium Carbonate to each 2 Gm. of Methylene Blue. This gave a stain in which blue elements overstained by using Jenner's directions, but by using Wright's method (covering film with a few drops of the Stain, allowing to stand 10 seconds, and diluting with two volumes of water) the resulting film was good.

We also found that the proportion of the Eosin Solution may be increased, *e.g.*, Eosin Solution 2 and (*Polychrome*) Methylene Blue Solution 1, gave good result.

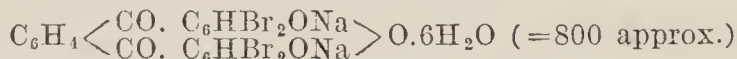
Romanowsky's Stain, Leishman's Modification.—There are various modes of making and supplying this stain. The following as suggested by Leishman gives the best results (the fixing and staining is done in one process so that fixing by heat is unnecessary):—

This is a solution in pure Methyl Alcohol of an Eosin-Methylene-Blue-precipitation-compound, 0.15 grammes of the compound being dissolved in 100 Cc. of Methyl Alcohol. The solution thus formed is a clear dark blue liquid showing a green iridescence by reflected light. The Stain is used by preparing films of blood in the usual way on clean cover glasses, and allowing to dry in the air. The films should be as thin as possible. Three or four drops of the Stain are dropped on to the film and the cover glass is rotated, no attempt being made to check evaporation as in the case of Jenner's Stain. After about half a minute six or eight drops of water are added, and allowed to mix by rotating with the Stain, and staining is allowed to proceed for five minutes

in certain cases ten minutes may be necessary. The film is now washed with distilled water, and a few drops of the water are allowed to remain on it for one minute. It is finally dried without heating and examined with an oil immersion lens.

(Note, the strength of the Stain may in some cases have to be increased somewhat, the volume of water added in staining may require modifying,—e.g., to the same volume as that of the stain or less.)

Note.—Leishman in his original paper (B.M.J. ii./01,757) directs Methylene Blue to Eosin* in proportion 10 to 1 to make the precipitation compound. Reckoning water-soluble Eosin as of formula



it may be pointed out that this does not appear to have any relationship with Methylene Blue which has composition $\text{C}_{12}\text{H}_6\text{N}_3\text{S}(\text{CH}_3)_4\text{Cl}=320$ approx.

1. Mol. Eosin of above formula should be equivalent 2 Mols. Methylene Blue = $2 \times 320 = 640$. In some experiments which we conducted using ordinary

Commercial Methylene Blue cryst. 6.4 Gm. ($= \frac{2 \text{ Mol. Wts.}}{1 \text{ Mol. Wt.}} \times 100$) and Eosin (water soluble, yellow shade) 8.0 Gm. ($= \frac{100}{1 \text{ Mol. Wt.}}$) in 1% solutions each; mixing

as directed, adding 2.8 Gm. ($= \frac{100}{1 \text{ Mol. Wt.}}$) of Sodium Carbonate cryst. and

boiling half an hour, collecting the precipitate and washing until runnings were of pale blue color, we obtained a better yield than by Leishman's Method. The precipitate, as above dissolved in the requisite proportion (0.15%) in Methyl Alcohol stained blood films satisfactorily. But even on these lines no chemical formula can be devised to show the reaction. The Stain appears to be based on experimental finding.

The following results are obtained:—

RED BLOOD CORPUSCLES are stained pink or greenish.

POLYMPHONUCLEAR LEUCOYTES red. Nuclear network blue. Extra nuclear protoplasm colourless. Fine eosinophile granules red.

MONONUCLEARS or HYALINE or LARGE LYMPHOCYTES.—Nuclei pale blue. Extra-nuclear protoplasm blue, occasionally showing red granules.

TRANSITIONAL.—As with large mononuclears, except nucleus is reniform.

SMALL LYMPHOCYTES as mononuclears, except nuclei deeper stained.

COARSELY GRANULAR EOSINOPILES.—Nucleus blue but not so deep. Granules pink.

BASOPHILES.—Granules deep-stained purple black. Nucleus red but usually somewhat masked by granules over-laying it.

NUCLEATED RED CELLS.—Nucleus almost black with sharp outline. Extra-nuclear portion grey.

MYELOCYTES stain pale red nuclei pale blue.

BLOOD PLATES deep red with spiky margins, often with pale blue peripheral zone.

BACILLI and MICROCOCCI blue.

*Eosins and Erythrosins.

The name **Eosin** is used for the Sodium or Potassium salt of tetra-brom-fluorescein, while the Alkali salt of dibrom-fluorescein is known as Eosin-Orange.

Eosin may be made from Fluorescein by brominating in presence of alcohol or water, in the former case with a little oxidising agent added.

Erythrosins are the corresponding Iodine compounds. The di-iodo body is known as Erythrosin 'G' or **Pyrosin**, the tri-iodo as Erythrosin 'A' and the tetra-iodo as Erythrosin 'B,' Iodo-eosin or Tetra-iodo-eosin. The latter two names are incorrect, **Eosins** being Bromine derivatives as stated. Commercial samples (German) may contain Sodium Sulphate, Sodium Chloride and other halides.—T. T. Cocking and co-workers, B.P. Conf., 1919.

Erythrosin, 0.2% solution injected has been used in conjunction with the Finsen lamp.

MALARIAL PARASITES.—Body stains blue and its chromatin deep red.—B.M.J. i./or, 635; ii./or, 757 (with some slight revisions by Wyatt Wingrave embodied). *Vide* also Malarial Parasites, this *Vol.*

Wyatt Wingrave finds that the addition of Glycerin (a small proportion) intensifies the Leishman and allied Stains and shortens exposure.

LEISHMAN'S STAIN (WRIGHT'S MODIFICATION).—Add Methylene Blue 1 Gm. to 100 Cc. of 0.5% Sodium Bicarbonate Solution. Sterilise in a flask in a steam steriliser for one hour. Place in a large dish and add while sterilising, 1 in 1,000 Eosin Solution (yellowish, soluble in water) until the mixture changes to purple and shows yellowish scum on the surface. About 500 Cc. if the Eosin Solution will be required. Collect precipitate formed, and dry in an incubator without washing. When thoroughly dry dissolve 0.3 Gm. of the powder in 100 Cc. pure Methyl Alcohol. Filter this saturated solution and add to the filtrate further 25% of Methyl Alcohol, *i.e.*, to 80 Cc. add 20 Cc. It is now ready for use.

Method of use.—Pour stain on to film and stain one minute. Add water drop by drop until greenish scum forms on surface (for $\frac{1}{4}$ inch cover glass 6 to 8 drops required), stain with this further two minutes, wash in distilled water and soak in same 2 minutes or more, until the thinner parts of film appear yellowish pink, dry with filter paper (no heat) and mount in Xylol Balsam.

Normal Erythrocytes appear yellow or pink. In cells deficient in hæmoglobin the colour is from a pale pink with large central clear space to dirty yellow. Polychromatophilic cells bluish. Granular degeneration or basophilic degeneration shows well as small bluish dots in a pink cytoplasm. Normo-blasts have a pink cytoplasm and blue nucleus (in some the cytoplasm is yellowish, purplish, or bluish). Megaloblasts show blue nucleus and yellowish or bluish cytoplasm.

The various solutions of Eosinote of Blue lose their differential staining power particularly with regard to the granules, after keeping a few weeks (especially in hot weather). Jenner's and Leishman's Stains may be "reactivated," by adding a very small quantity of the original powder.—Wyatt Wingrave.

Modified Leishman Stain, using Dibromo-dinitro-fluorescein in place of ordinary Eosin.

Note.—Dibromo-dinitro Fluorescein has *Syn.* **Eosin B. N.**, **Methyl Eosin** (wrongly so-called) and **Eosin Scarlet B.**

By Romanowsky Staining is meant the production of blue in basophile cytoplasm and violet to magenta in nuclei and some other structures by the stain. Leishman's method though good for parasites is said to give feeble staining of the eosinophile and neutrophile leucocyte granules. The following is said to produce uniform results as regards the blood cells. Add to a filtered solution of Methylene Blue (the strength is immaterial), with stirring, a similar solution of the 'Methyl Eosin' until the mother liquor is only faintly blue,—then add cautiously—often at this stage a weaker solution is desirable—to exactly neutralise. The end reaction is seen by running a drop of the liquid down a sloping glass plate behind which is some white paper—collect precipitate on tough filter paper without pressure, wash with water and dry at not exceeding 50° C. Prepare the stain by dissolving 0.15% of the precipitation compound in pure Methyl Alcohol.

(a) To produce pure blue and pink staining, as distinct from Romanowsky's effect, add 6 drops of the stain to an air dried film. Pour off into 1 Cc. of water in test tube, mix, pour back on to slide spreading with mouth of the inverted test tube. Leave 10 minutes, then wash for a few seconds with distilled water, blot to dry.

(b) To produce Romanowsky's staining. If violet nuclei are preferred, use three drops of the Eosin Scarlet Methylene Blue Stain and three of **Eosin Toluidine Blue** (made similarly but of 0.1% strength).

For staining deeper use 4 drops Eosin-Scarlet Methylene Blue, and 3 drops Eosin-Thionin (0.04%).—Jl. Path. and Bact., July 1911, p. 148.

NOTE.—We have prepared the Eosin Scarlet Methylene Blue using a 1% solution of the Blue, and a 1% solution of the Eosin Scarlet. We found that 110 Cc. of the latter to 100 Cc. of the former was about the correct proportion.

It is not practicable to produce a solution stronger than 0.15% of the precipitation compound in Methyl Alcohol.

An independent report with this stain says—results excellent, quick and reliable,—good for differential counting. Was best employed as follows:—

Flood film for at least three minutes with the stain; dilute with its own volume of distilled water, rock five minutes and wash five times with distilled water.

Wingrave's Simplified Blood Stain.

Two stock solutions are used:—

I. Methylene Blue saturated solution in 90% (Rectified) Alcohol

II. Eosin (Water Soluble) saturated aqueous solution.

Directions.—Well mix 4 Cc. (about 60 drops) of No. I. with 1 drop of No. II. Flood the film in a Petri dish for three minutes, then add 2 or 3 drops of Distilled Water and stain for 3 to 5 minutes, oscillating constantly, wash well in Distilled Water, then dip into a developer composed of tap water 100 Cc., Glacial Acetic Acid 2 drops, several times quickly and dry with best filter paper. Mop off excess and examine direct. Should Eosin be in excess nuclei will be pale, therefore add more blue. Filtering is not necessary.—Wyatt Wingrave, M.P.C. i./14,356.

May Grunwald's Stain is a Methylene Blue—Eosin Mixture similar to; Jenner's Stain, which was used for typhoid diagnosis.—B.M.J. ii./o6,1848 B.M.J.E. ii./o6,77.

Method of distinguishing dead and living Leucocytes by means of Neutral Red. Mix 10 drops of a solution of Sodium Chloride 0.9% containing 0.6% Sodium Citrate with 10 drops of a solution of Sodium Chloride 0.9% containing Neutral Red 0.1%. Add 1 drop of blood or 1 to 4 drops of the sediment of a centrifugalised exudate containing leucocytes. Place in the incubator and maintain at 37° C. for twenty minutes, then count the leucocytes (living stained red and the dead ones not coloured). In circulating blood there are no dead leucocytes even in the most grave diseases. In abscesses the number of dead leucocytes suddenly decreases after an incision. In acute meningitis it appears the variations in the dead leucocytes is valuable for diagnosis; their disappearance is a good sign; increase an unfavourable one;—a few stained nuclei are found in old suppurations, for instance in tuberculous empyema amongst a great deal of leucocytic remains.—B.M.J. ii./10,1416.

Calcium Salts in Blood, Estimation of by Blair Bell's Calcimeter, v.p. 45.

Sugar in Blood. Methylene Blue Test.

Mix equal parts of a 1 in 1,000 aqueous solution of Methylene Blue and Liquor Potassæ. To 5 Cc. of this in a test tube add 5 drops of blood from finger, mix and heat gradually in water bath. When sugar is present the blue disappears. Sugar is a normal constituent. We found 0.1 Cc. of 0.5% Glucose will decolorise the blue by this test.

Method of estimation by means of the Hellige Colorimeter.—See 'Blood and Urine Chemistry.'—Gradwohl & Blaivas, 1920.

A micro-chemical method of estimating.—R. S. Mackenzie Wallis & C. D. Gallagher, L. ii./20,784.

Blood Pressure is determined by some form of the Riva Rocci Sphygmomanometer, e.g., that of Lockhart Mummery.

Directions are supplied with the instruments. Another modification of the Riva Rocci Sphygmomanometer is that of C. J. Martin, which is now the leading instrument for the purpose.

Oliver's Hæmomanometer—The latest pattern is a mercurial one and consists of a U tube, which differs from the ordinary form in that it is extended up above the inlet and curves down again to almost meet it. This end may be open or closed to the air and has an indicator for this purpose. When readings not above 200 mm. are required, the right limb is open to the air and the readings on the left are taken. For readings from 200—300 mm. the right limb is closed.

The whole apparatus with stand can be packed together and is unspillable.—Pr., Jan., 1914.

Viscosity of the Blood is determined by the aid of the Viscosimeter (Du Pre Denning and Watson)

Coagulation Time of the Blood.

Sir A. E. Wright's Blood Coagulation Tubes are used for measuring the coagulability of the blood.

A series of tubes of a standard calibre, 0.25 mm. (approx. $\frac{1}{16}$ inch), are filled in with blood taken with certain precautions from the finger tip. The coagulability determination is made at a standard temperature, 18.5° C., and the "coagulation-time" is determined by blowing down tube after tube in succession at increasing intervals from the time of filling in.

Normal blood generally has a "coagulation-time" greater than three and less than six minutes.

In many cases, as, for instance, in cases of persons of a "lymphatic" habit of body, and in persons who suffer from chilblains, or urticarias, or spontaneous hæmorrhages, further, in persons who have suffered severely from malarial and other fevers, and pre-eminently in the subjects of hæmophilia, blood coagulation will be found to be very much reduced. Coagulation times of fifteen minutes are not very uncommon in the former classes of cases. In the case of "bleeders" coagulation times of an hour or more are occasionally found.

The following are less exact methods:—

Capillary tubes 6 inches long with internal diameter 1.5 mm. are filled the moment the blood flows from the finger on incision. On breaking the tube (and the column of blood) fibrin formation indicates coagulation point—the time taken is noted. The variation in temperature of the room is negligible.

Another method, and simpler, is to drop the blood from a broken capillary tube on to a glass plate. Seal the fractured end of the tube and use the sealed end as a rod to dip from time to time into the drop of blood. Ultimately a fine thread of fibrin will be drawn up—this is the coagulation point; the time can be ascertained to a second.—*C.f. also Vol. I., p. 248.*

There is a lessened coagulability in hæmophilia.

Reaction of the Blood, Determination of.

This method depends on the appearance of a precipitate when a definite amount of Acid is added to a definite amount of diluted blood. A series of small tubes are prepared containing quantities of $\frac{N}{1000}$ Sulphuric Acid rising by 0.1 Cc. from 0.0 to 1.2 Cc., the volume in each case being made up to 2 Cc. with Distilled Water. A drop (0.02 Cc.) of blood is then added to each tube, the contents well mixed, and the tube placed in a water-bath at 45° for one hour. With average human blood the tubes containing the smaller amounts of Acid show a slight opalescence, but a coarse, flocculent precipitate makes its appearance when the tubes containing 0.7—0.9 Cc. of Acid are reached. The appearance of this precipitate is considered to indicate the neutralisation point. The reaction is given equally well by fresh defibrinated, oxalated or citrated blood and by red corpuscles washed many times with salt solution. It is not given by citrated or oxalated plasma, by serum or by a solution of fibrin. It is supposed that the precipitate consists of the nucleo-protein of red cells.—*J.C.S.A. ii./10,317 ex Arthur E. Boycott and R. A. Chisholm (Bio-Chem. Jl., 1910, 5, 23-31.)*

F. Gowland Hopkins deals with the modern views on the Chemical Reaction of the blood and changes which occur.—*L. i./14,1589.*

Reactivity of the Blood in relation to cardiac breathlessness, surgical shock, etc. The 'strip' of variation in acidity or alkalinity of the plasma of the blood within which life is possible is a very narrow one, and it suffices to render the medium within which living cells are situated acid or alkaline to the feeble limit of one-thousandth normal, or less, in order to destroy life. Blood plasma is capable of being able to neutralise large amounts of either acid or alkali without itself being or becoming markedly acid or alkaline. A consideration of the variations in the property of balanced alkalinity and acidity (HYDROGEN ION CONCENTRATION).—*Sir Benjamin Moore, B.M.J. ii./18,251. c.f. Prof. Bayliss, ibid. 78.*

Hæmagglutinin Reaction as a test of the toxicity of various antiseptics. As to action on the red blood corpuscles antiseptics may be divided into two classes: (1) those which agglutinate red blood corpuscles without destroying them, *e.g.* Acriflavine and 5% Saline and to a less extent Mereury Biniodide and Iodine; (2) those which hæmolyze the corpuscles without producing agglutination, *e.g.* Chloramine and Phenol. Action on leucocytes and pus cells. Acriflavine compares favourably with Phenol, Chloramine, etc. Action on Blood Serum. Chloramine, Phenol and Hypertonic Saline destroy the

hæmagglutinins in serum. Acriflavine, Hydrogen Peroxide in certain concentrations and Iodine to a less degree do not.—C. J. Bond, B.M.J. ii./17,751.

IODINE GLYCOGEN REACTION on blood contents. The white blood corpuscles, especially the polymorphs in health and in some infective diseases, frequently give a colour reaction with iodine. This is regarded as evidence of the presence of glycogen in the cells. It is also given by many pus cells in some of the cellular elements of granulation tissue, in some marrow cells and in the cells of certain cancerous tumours. The colour is not the same in disease as in normal circumstances. It is port wine or mahogany in disease and mauve coloured in health. The substance responsible for the colour in health is either glycogen or a precursor of it. Routine investigation of cells of various kinds of malignant growths on these lines may throw light on metabolism of the cancer cell.—C. J. Bond, B.M.J. i./17,145,164.

Ehrlich-Biondi Stain *Syn.* EHRLICH-BIONDI-HEIDENHAIN MIXTURE
EHRLICH'S TRIPLE STAIN.

This nuclear stain is prepared by dissolving separately Methyl Green 1 Gm. in water 200 Cc., Acid Fuchsin 1 Gm. in water 80 Cc., Orange G. 4 gm. in water 400 Cc., and mixing afterwards. The stain is then ready for use; it is *not* to be further diluted. Sections should be allowed to stain from 6 to 24 hours. Dehydration is effected with Alcohol, and the sections are cleared with Xylol and mounted in Xylol Balsam. Slides stained 2 to 10 minutes by this process show:—

ERYTHROCYTES, orange. NEUTROPHILE POLYMORPHONUCLEAR GRANULES, violet.

NEUTROPHILE MYELOCYTES, violet. ACIDOPHILE GRANULES OF THE POLYMORPHONUCLEAR CELLS, brick red. BASOPHILES, not stained. LYMPHOCYTES, Nuclei, pale greenish blue. CYTOPLASM, faint pink or grey. In disease the nuclei of the erythroblasts are greenish black. This triple stain should be distinguished from—

Triacid Stain.

Orange G. saturated aqueous solution 12, Acid Fuchsin saturated aqueous solution 8, Methyl Green saturated aqueous solution 10, water 30, absolute Alcohol 18, Glycerin 5.

The former of these two stains is the more used. The Triacid Stain appears to be more powerful, but is perhaps less delicate.

Ehrlich's Hæmatoxylin Solution.

Dissolve Hæmatoxylin 1.5 gm. in Alcohol Absolute 100 Cc., and mix the solution with a 100 Cc. of saturated solution of Ammonia Alum in water to which has been added Glacial Acetic Acid 5 Cc. and Glycerin 100 Cc.

Grenacher's Alum Carmine. Carmine 1, Alum 5, water 100. A small amount of Phenol may be added to preserve. For nuclei and muscle staining.

Grenacher's Hæmatoxylin Solution.

Dissolve Ammonia Alum 45 in water 430. Dissolve separately Hæmatoxylin 2.4 in Absolute Alcohol 12. Mix and allow to stand for 14 days. Filter and add Glycerin 66 and Alcohol 90% 75 Cc.

Delafield's Hæmatoxylin Solution is similar.

The presence of Methyl Alcohol in addition to Ethyl Alcohol is unnecessary in Delafield's Hæmatoxylin Solution. A series of sections (showing mitosis) stained with batches of the stain made with (1) the usual mixture and (2) with Ethyl Alcohol, alone showed practically no difference in the depth of stain and sharpness of definition in the chromosomes.—H. Garnett, P.J. i./18,127.

Borax Carmine. This solution is prepared by boiling Alcohol 70% with Carmine and Borax in excess, and filtering after cooling.

Mayer's Stains: Carmalum—Carmine 2, Alum 5, boil 1 hour with water 100, filter. **Hæmalum**.—Hæmatein [$C_{16}H_{12}O_5 = 300.176$]. 1. dissolved in alcohol Absolute 50. Mix this solution with one of Alum, 50 in water 1,000. Acid Hæmalum consists of the above, with 2% Acetic Acid added. **Hæmatoxylin or Kleinenberg's Hæmatoxylin Solution.** To a saturated 70% Alcohol Solution of Alum and Calcium Chloride diluted with 6 times the amount of Alcohol of the same strength, is added Alcoholic Solution of Hæmatoxylin, until the characteristic violet colour is produced. **Paracarmine**.—Carminic Acid 1, Aluminium Chloride 0.5, Calcium Chloride 4 in Alcohol 70% 100. **Picrocarmine**.—Saturated Picric Acid solution is added to a solution of Carmine 8 Gm., in 100 Cc. of Ammonia until a precipitate commences to form.

Perenyi's Solution (Hardening Reagent).—Dissolve chromic acid 0.15 Gm. in water 30 Cc. and add alcohol 30 Cc. and nitric acid (10%) 40 Cc. Employed for fixing plant and animal preparations.

Hydrogen-ion Concentration of the Blood.

A series of Standard Solutions are required of known "pH" to be used in conjunction with a delicate indicator which will show easily recognised changes in colour due to Hydrogen-ion concentrations approximating that of the solution tested.

The method has been used by Henderson and by Walpole on the urine, but in the case of blood, coloring matter and proteins must be excluded by dialysing.

Collodion Sacs are employed. Blood dropped into these and dialysed for five minutes is free from interfering bodies but contains salts which are responsive to **Phenolsulphonephthalein**—an indicator showing differences in tint between pH 6.4 and 8.4.

The following solutions are first prepared:—

A. **N/15 Acid Potassium Phosphate** (KH_2PO_4) **Solution.** (9.078 Gm. per litre of fresh Distilled Water).

B. **N/15 Sodium Phosphate Solution** containing 11.876 Gm. per litre of $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$ or the equivalent of the salt with $12\text{H}_2\text{O}$.

Mix solutions A. and B. as follows:—

pH	6.4	6.6	6.8	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	8.0	8.2	8.4
A.	73.0	63.0	51.0	37.0	32.0	27.0	23.0	19.0	15.8	13.2	11.0	8.8	5.6	3.2	2.0
B.	27.0	37.0	49.0	63.0	68.0	73.0	77.0	81.0	84.2	86.8	89.0	91.2	94.4	96.8	98.0

Place 3 Cc. of each of the mixed solutions in 100 by 10 mm. test-tubes, add 5 drops of 0.01% Phenolsulphonephthalein to each and seal off the tops. The series of colours so prepared represent different concentrations of Hydrogen-ions within limits likely to be found.

Collodion Sacs. The collodion is directed to be made by dissolving 1 ounce of Pyroxylin in Ether 250 Cc. and Alcohol 250 Cc. Allow to deposit and use the supernatant solution.

A good piece of glass tubing scaled off like a test-tube with internal diameter 10 by 120 mm. is used as a mould. Fill it with the collodion then invert it and pour out half the contents. Then place it upright and allow the collodion to fill the lower half again. Invert a second time and rotate on its vertical axis, the collodion being drained off. This must be done to render even. Now clamp the tube inverted and allow to stand 10 minutes, then soak bodily in water for 5 minutes. Loosen the upper rim with a knife and run a little water between the sac and the tube, gradually pull out the sac, and preserve under water.

To conduct the Determination:—

The assay must be done in a room free from fumes of acids or ammonia.

Place 1 to 3 Cc. of clear serum or of blood to be tested in a sac which has been washed inside and out with 0.8% Sodium Chloride solution—the sac having been previously tested for leaks by filling it with the salt solution.

Lower the sac into a test-tube 100 by 10 mm. inside diameter containing 10 Cc. of the salt solution until the fluid outside is as high as on the inside. Dialyse for 5 to 10 minutes. Remove the sac and add 5 drops of the indicator, mixing thoroughly with the dialysate and compare colour with the set of standards against a white background.

The limits of error are very slight. The same results are obtained with 1 Cc. or 3 Cc. of blood, and it is immaterial whether there is 1 or 3 Cc. of salt solution.

A mild case of acidosis gave an average of 7.55 on repeated examination using serum, and the oxalated whole blood from the same case gave an average of 7.25.

Theoretical Notes on the Subject.

A solution is acid when it contains an excess of Hydrogen over Hydroxyl-ions, neutral when they are equal in numbers, alkaline when Hydroxyl-ions predominate.

An acid of "normal" strength is viewed to contain in 1 litre 1 Gm. of Hydrogen capable of forming Hydrogen-ions and its strength may be viewed as 1 N. Pure water, however, dissociates to form Hydrogen- and Hydroxyl-ions and at 20° C. contains approximately 1/10,000,000 Gm. of Hydrogen-ions to the litre and an equivalent amount Hydroxyl-ions. That is to say: pure water, our standard of neutrality, is 1/10,000,000 N acid and also 1/10,000,000 N alkaline. For brevity this fraction may be expressed 10^{-7} N. Sorensen suggests dropping the 10 and the minus sign and calling it pH7. If there is less than 1/10,000,000 Gm. of Hydrogen-ions in one litre the solution is less acid than water, i.e. it is alkaline—so pH8 means actually 1/10,000,000 N alkali.

To conclude:

pH1 = N/10 acid.

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pH6 = N/1,000,000 acid.

pH7 = NEUTRALITY.

pH8 = N/1,000,000 alkali.

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pH14 = N/10 alkali.

The reaction of the blood serum varies approximately between pH7 and pH8, the neutral point, pH7, being reached only in severe uncompensated acidosis and a reaction of pH8 being attained perhaps only after administration of alkalis.

For further data see Gradwohl and Blaivas' "Blood and Urine Chemistry," 1920 (Kimpton); see also the original communications of Marriott, Levy and Rowntree, Arch. Int. Med. 1915, Vol. XVI., p. 389, and 1916, Vol. XVII., pp. 840—851. Prof. Haldane provides numerous references to the subject.—B.M.J., ii/19,295

Calculi.

Urinary Calculi.

A mineral deposit composed of concentric layers of crystallised or amorphous substance cemented together by mucus or other organic material occurring in the pelvis or the kidney or bladder or urethra. Urinary calculi (sand, gravel or stones according to size) may be classified as follows:—

(1). Those containing a mixture of *Uric Acid with Urates*, with either little or no phosphates; (2). *Mixed calculi*.—those containing more phosphates than Uric Acid; (3). *Calcium Oxalate Calculi*; (4). *Phosphatic Calculi*—composed of Calcium Phosphate. Triple Phosphate or a combination of Calcium and Magnesium Phosphates; (5). *Calcium Carbonate Calculi*; (6). *Cystin Calculi*; (7). *Xanthin Calculi*.—Gould.

Renal Calculi.

Chemical composition.—Calcium is always the base present, the main acid component may be Oxalate, Phosphate or Urate. The Calcium salt of each of these three Acids is the most insoluble one which exists, this is the reason why it is the invariable one present in renal calculi. It is impossible to associate the 'Mulberry Stone' or 'Jackstone' always with Calcium Oxalate, the 'Pebble' with Urates, etc

The formation of renal calculi 'has for its basis a condition of diminished oxidation, in which there appear primarily Calcium Salts of incompletely oxidised bodies such as Calcium Oxalate and Calcium Urate associated with Calcium Phosphate.'

Method of analysis.—Determined moisture in the finely powdered stone,—this was found to be 1 to 18% max. in 24 stones examined. Examined qualitatively for NH_3 , Xanthine, Cystine, Magnesium and Sulphates—these were invariably absent. Calcium was the only base in appreciable amount. Determined the total Nitrogen (usually about 1 to 7% as average). Determined Phosphoric Acid by treating with strong Nitric Acid (destroying all organic matter) precipitated as Ammon-phospho-molybdate, washed free from Acid, dissolved in standard Alkali and titrated back with standard acid.

In another portion (larger) separated Oxalates and Urates by treatment with Hydrochloric Acid (1 in 4), determined Uric Acid by Potassium Permanganate in the insoluble residue, threw down Calcium Oxalate along with Phosphate by adding Ammonium Chloride and NH_3 to the Acid Solution, filtering into a Gooch crucible, washing thoroughly until Chlorine free, dissolving in Sulphuric Acid and titrating with Permanganate. Results showed with Calculi from kidneys and ureters; Calcium Oxalate mostly about 80 to 99%. Calcium Phosphate either none or up to 40 or even 60%, where Oxalate low. Uric Acid 1 to 10%. Two (from the bladder) out of the 24 Calculi examined were almost pure Uric Acid,—all the others contained Calcium Oxalate,—only one less than 30% and more than $\frac{2}{3}$ of them over 70% of this salt.—Benjamin Moore, B.M.J. i./11,739.

Urethral Calculi formed *in situ* primarily in the prostate gland and eventually in pockets communicating with the urethra. Examination of encysted calculi in diverticula which communicated with the floor of the prostatic urethra near the neck of the bladder showed in one case Calcium Phosphate 61.5%, Calcium Oxalate 30.8%, Uric Acid 3.9%. *Case 2.*—Calcium Phosphate 94.3%, Uric Acid 1.5%, Calcium Oxalate 2.3%. *Case 3.*—Calcium Phosphate 60.91%, Calcium Oxalate 13.36%, Calcium Carbonate 5.96%. The presence of Calcium Oxalate in a calculus cannot be accepted as evidence that it had descended from the urinary channel above. It has previously been accepted that only phosphatic stones are formed *in situ*, and that urate, uric acid and calcium oxalate stones found in diverticula must have come down the urethra from above.—B.M.J. i./12,3.

A cystinuric may pass crystals of cystin (*q.v.*) for years and yet not suffer from cystinuria,—the mere fact of a sparingly soluble substance being present does not necessarily cause formation of a calculus,—the same applies to other varieties of urinary *calculi*,—oxalic, uric and phosphatic alike.—Sir A. E. Garrod, B.M.J. i./11,1416.

Cast.

In the diagnosis of the cause of albuminuria associated with the presence of renal tube casts, it is remarked that owing to improvements in centrifuges, etc., technique has become almost too perfect. Care must, therefore, be taken to distinguish sufficiency of casts to be of pathological significance from 'occasional' casts.

The matrix or groundwork of casts is a structureless material thought to be due to some kind of protein coagulation. They consist frequently of this matrix alone, and according as they are then less or more highly refractive they are called *Hyaline* or *Waxy* respectively. The Hyaline is the commoner, but neither is characteristic of any particular disease. If renal epithelial cells are embedded in the hyaline matrix, the cast is called an **Epithelial cast**, if leucocytes or pus corpuscles, a **Leucocytic cast**; if red blood corpuscles a **Blood cast**; if bacteria a **Bacterial cast**; if fat globules (degeneration products of renal cells or leucocytes) **Fatty cast**; if non-fatty granular debris **Granular cast**. The cast may be a **mixed** one, *e.g.*, one part hyaline, at one end granular and at the other epithelial. On the whole hyaline casts occur in all forms of nephritic conditions, whether acute or chronic. Epithelial and Leucocyte casts point to active catarrh, Granular ones tend to occur along with Epithelial casts, but when they are alone or in association with Hyaline casts they are evidence of at least less acute mischief than are Epithelial casts, while Fatty casts come between the two. Blood casts may occur in almost any variety of renal hæmorrhage, though in association with other casts they indicate very acute inflammatory changes.—H. French, B.M.J. i./11,418.

Cerebro-Spinal Fluid.

Possible functions of the cerebro-spinal fluid—its composition is virtually Locke's Modification of Ringer's Solution.—W. D. Halliburton, B.M.J. ii./16 609.

In examining a specimen centrifugalize or allow to stand for any sediment to deposit. Examine sediment for cells and Bacteria. Leucocytes indicate an acute process, *e.g.*, septic. Lymphocytes in excess—a chronic process such as tabes; tubercular meningitis, &c.

Red corpuscles when intact indicate hæmorrhage of meninges.

If the fluid be clear, test for Globulin by Salicyl Sulphonic Acid and other Tests, also by Spiegler's Solution, *v.* Albumin and Globulin (and Noguchi's test for parasyphilis, *vide* Syphilis).

Inoculate broth and other media for Bacteria.

Normal cerebro-spinal fluid is clear, colourless, and alkaline; the degree of alkalinity varies. By titration it is shown to be always diminished in infection. It becomes slightly turbid when boiled. The fluid may become coloured. Yellow fluid may indicate tuberculous or chronic meningitis or tumour of the spinal cord; in subdural hæmorrhage or cerebral laceration it is red, but if the trauma be some days old the colour may be dark amber. Red colour may be due to accidental contamination; coagulation in the test tube is stated to be an infallible sign of this, but such a conclusion is not always justifiable. It has been stated that bile does not appear in the fluid in cases of jaundice; one of the cases described contradicts this. Turbidity is an indication of meningitis, but the fluid may be clear in subacute tuberculous meningitis. It is clear also in extradural hæmorrhage and in cerebral tumour.

A film made from normal cerebro-spinal fluid contains very few leucocytes and many fields may be examined before one corpuscle is found. Absence of leucocytes excludes meningeal inflammation, locomotor ataxy, and superficial gumma of the brain. It does not exclude cerebral abscess unaccompanied by meningitis; this shows the value of making a leucocyte count of the blood at the time the cerebro-spinal fluid is examined.

In pathological states the number of leucocytes is increased, and in inflammatory conditions a varying number of endothelial cells may be seen.

The method of conducting rachicentesis is provided.—James Rae.—B.M.J. i./11, 1424. See also Cerebro-Spinal Fever, this Vol. and F. W. Mott, —Cerebro-spinal Fluid—Pathology, properties, chemical alterations, Examination in Sleeping Sickness, Syphilis and Parasyphilis.—L. ii./10, 79.

Diplococcus in the blood in cerebro-spinal meningitis, in addition a marked early polynuclear leucocytosis,—early slight cases can be diagnosed by these.—B.M.J. i./12, 54.

Method for determining the absolute pressure of the cerebro-spinal fluid.—P.R.S.M. Clin. Section, 1911, 58.

Sugar.—The fluid reduces Fehling's Solution. It contains normally 0.1 to 0.5% Glucose. In pyogenic meningitis, pneumococcus, streptococcus and mixed infection Sugar (capable of reducing Fehling) is invariably absent from cerebro-spinal fluid. In cerebro-spinal meningitis sugar is absent in the acute stage but may return in some degree as the infection recedes. In tuberculous meningitis sugar is present except in very rare cases shortly before death, in which stage difficulty of diagnosis rarely exists. In poliomyelitis sugar is present.—F. H. Jacob, B.M.J. ii./12, 1097. Test by means of Methylene Blue test as under *Blood*.

Differential Diagnosis of Syphilitic from the Parasyphilitic affection by examination of cerebro-spinal fluid.

Normally the fluid is practically free from corpuscular elements as stated *antea*—from 1 to 5 lymphocytes may be seen in the centrifugalised deposit in the ordinary microscope field. In acute microbial infections of the cerebro-spinal meninges as by *staphylococcus*, *pneumococcus*, etc., leucocytosis occurs mostly of the polynuclear type.

In certain more chronic affections as in tubercle, trypanosomiasis and syphilis excess of leucocytes also occurs—mostly *mononuclear*, *i.e.*, there is a lymphocytosis or pleocytosis. Tubercle bacillus and trypanosomes can usually be found, but the *Sp. Pallida* has not been found, in its ordinary form at least. The pleocytosis of cerebro-spinal syphilis, tabes and general paralysis is often a very early occurrence of great diagnostic value.

In florid syphilis and in cerebro-spinal syphilis as well as in tabes and general paralysis, the Wassermann reaction is practically always +.

The second reaction in *diagnosis of parasyphilitic affections* is the finding of an excess of globulin by the Nonne Apelt method:—Mix the cerebro-spinal fluid with Saturated Ammonium Sulphate Solution. Turbidity = excess of Globulin.

This always occurs in tabes, general paralysis and cerebro-spinal syphilis. In combination with a + Wassermann Reaction and pleocytosis it is pathognomonic of parasyphilis.

The third reaction is the pleocytosis; the fourth, is the Wassermann reaction, both already mentioned. The four reactions are relied upon for diagnosis. At least 95 to 100% of both tabes and general paralysis give a + reaction — using the latest method.—Hauptmann's Auswertung's Method.

Finally the great test is the therapeutical one. In cerebro-spinal syphilis Mercury or '606' in most cases will convert a + reaction to —. In parasyphilitic affections—tabes and general paralysis, this treatment is of no avail.—Sir David Ferrier, L. ii./13,1109.

Lange's Colloidal Gold Test in cerebro-spinal fluid found to be in great measure specific.—B.M.J.E. i./20,32 68.

Colloidal gold solution is red. When certain spinal fluids are mixed with it the colloid particles are precipitated. Numbers are given to the colours formed: red=0, red-blue=1, violet=2, blue=3, bluish-white=4, and colourless=5. Ten dilutions are made varying from 1/10 to 1/5120. Results are given from left to right. In *general paralysis* a typical reading would be 5555554210 (the 'paretic curve'). In tabes the figures may be 2221110000. In cerebro-spinal syphilis 1223320000 is fairly typical.—A. Douglas Bigland L. ii./20,587.

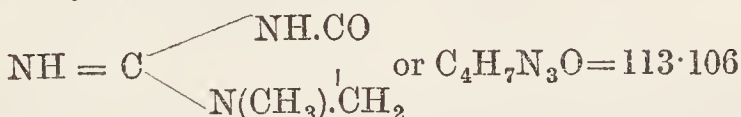
Experiments with cerebro-spinal fluid.—J. E. R. McDonagh, *ibid.* 991.

Chlorides in Urine.

Instead of evaporating and incinerating with ammonium nitrate, oxidise the organic matter contained in 10 to 20 Cc. urine with potassium permanganate, *q.s.*, and sulphuric acid 2 Cc., warm, then neutralise with potash in presence of litmus paper. Dilute to 50 Cc. with water, add potassium chromate and titrate with silver nitrate as usual.

Creatinine.

Glycocoll-Methyl-Guanidin.



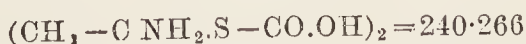
To test for this body in the Urine add a little Sodium Nitro-Prusside and Caustic Soda. A red colour develops which fades on boiling the mixture. If a little Acetic Acid be added to the boiling liquid, Prussian Blue is produced.

Retarding effect of Creatinine, Creatine and Mucin on the precipitation of Cuprous Oxide from Fehling's Solution. Urates have auxiliary effect.—L. ii./06,1136, ii./07,290.

Excretion of Creatinine in diabetes mellitus.—There appears to be some connection between carbohydrate metabolism and the Creatine-creatinine metabolism. Experiments with diabetic urines showed that Creatinine was not increased to any extent even when patients were on a highly nitrogenous diet. Creatine on the other hand, a substance never found in the normal urine if the diet be free from Creatine and Creatinine was always found—even when patient was on a Creatine-Creatinine-free diet.—B.M.J. ii./10, 1343.

Creatinine and Creatine in Blood. Method of estimation by means of the **Hellige Colorimeter**.—See 'Blood and Urine Chemistry.'—Gradwohl and Blaivas, 1920.

Cystin.



Cystin is a cleavage product of protein-metabolism, apparently loosely bound and easily split off at an early period of the intestinal digestion. Normally it becomes oxidised and hence is unrecognisable, but in cystinuria it is excreted unchanged.

Separation of Cystin. Free from oxalates and phosphates by Ammonia and subsequent addition of Calcium Chloride until this no longer precipitates, add equal volume of Acetone and Acetic Acid in slight excess. Cystin crystallises out in 3 or 4 days, and may be purified by dissolving in Ammonia and reprecipitating —Maun

Is occasionally found in urinary deposits as transparent six-sided crystals—insoluble in alcohol but soluble with ease in mineral acids, caustic alkalis and ammonia. Uric acid occasionally crystallises in similar form, but gives the murexide reaction; Cystin does not.

Sir A. E. Garrod on Cystinuria.—L. ii./o8,142,214.

Fæces, Examination of.

This is undertaken to determine the state of the various digestive functions, and to assist thereby the treatment of gastric and intestinal disease.

A trial diet is necessary. Various 'meals' have been suggested with the inclusion of Carmine, Carbon, etc., to mark the commencement. The author of this paper advises, however, ordinary meals during 48 hours as follows, to include (1) Milk undiluted or mixed with coffee, (2) Eggs, (3) Animal food such as fish, poultry, veal, beef, etc., (4) farinaceous foods—bread, potatoes, rice, (5) the various green vegetables and roots, (6) stewed fruit, (7) butter and various fats of meat.

The fæces are collected in a glass vessel—this permits macroscopic examination (**constipation**, etc.).

Bile, Secretion of. Stir a portion with concentrated aqueous Perchloride Solution. Normally after some hours all the portions containing *hydrobilirubin* take on a red colour, while those containing *bilirubin* take on green. An indistinct reaction shows that bile secretion is inhibited.

Fermentation—Set aside a portion in a fermenting flask.

Distinct gas evolution in twelve hours shows that **Starch Digestion** has not been satisfactory. The fæces in this case are distinctly acid—catarrh affections of the small intestine. Gas evolution after 24 hours or later shows that the albuminous substances are being split up by the increased alkalinity of the fæces. In the former case there is **intestinal fermentation dyspepsia** and in the latter **intestinal decomposition dyspepsia**.

Fats.—All that is necessary is to determine the proportion of *split up* to *total fat*. The splitting up of fats takes place in the small intestine. One determines how much of the total fatty substance present in the fæces appears as *neutral fat*, how much as *soap*, and how much as *fatty acid*. Extract 2 to 3 Gm. in a Soxhlet with Absolute Alcohol, then with Chloroform for six hours. The residue on evaporation contains *all the fats*. Titrate with Alcoholic $\frac{N}{10}$ KOH. Result: Fatty Acid + Soaps—the triglycerides being calculated as Stearic Acid, the No. of Cc. of Alkali $\times 0.0284$ gives the amount in Gm. of fatty acid and soaps (Acid Stearic M.W. = 284). The difference between total fat and fatty acid = neutral fat. About 75% of the fats ingested should be split up into soaps and fatty acids and the more the dissociation differs from the normal the greater the amount of neutral fats formed. The average amount of fat taken in health is 125 Gm. *p.d.* This would correspond normally to about 20 Gm. of total fat in the fæces. *The greater the amount of total fat the more defective the fat absorption.*—B.M.J. ii./10,409

In pancreatic disease the fat content in the fæces is much increased.—Hewlett, P.J. i./13,248.

Blood.—Benzidine may be used, *e.g.*, make an aqueous extractive filtered about 1=4. To about 2 to 3 Cc. add $\frac{1}{2}$ Cc. of 10 vol. H_2O_2 , and then add 1 Cc. of 1% Benzidine Solution in 50% Acetic Acid and note blue colouration.

Rub up a piece the size of a walnut with equal volumes of Alcohol and Ether, filter and repeat until a colourless filtrate is obtained, then extract the residue with 4 Cc. of Glacial Acetic Acid and when this has drained off use a further 4 Cc. Shake out the combined filtrate with two or three times its volume of Ether and then with water *q.s.*, to make the separated liquids $\frac{1}{2}$ Ether layer and $\frac{1}{2}$ water. Run off the acid aqueous layer, wash the ethereal with water and then treat with 5 to 10 drops freshly made pale yellow Guaiacum Tincture and 20 drops of Hydrogen Peroxide. In presence of blood a blue to violet colour forms.—Pharm. Zeit., 1913,128; Y.B.P., 1913,43.

Microscopic Examination.—The presence of *connective tissue* and *elastic fibres* indicates a defect in acidity of the gastric juice. Defective dissociation of connective tissue and coagulable proteins points to a primary gastric affec-

tion known as *achylia gastrica* (*Hayem's hypopepsia*). Appearance of elastic fibres, if not associated with connective tissue and coagulated protein, must be regarded as a sign of good gastric, but defective intestinal digestion. Considerable amount of undigested muscle fibre with well-marked contour may indicate bad intestinal digestion of meat.

For detection of *B. Tuberculosis* in, by Antiformin, *v. B. Tuberculosis*.

Cereal products, Vegetables, etc., can be recognised microscopically.

Starch.—Lugol's Solution detects. When unchanged and clumped together there is *deficient pancreatic enzyme*. On the other hand, *swollen granules* almost always indicate *catarrhal affection* of the small intestine where the digestion of the starches chiefly takes place.

Mucus.—Stain smear with 1% Sodium Alizarine Sulphate. Normal mucus appears as small flakes and scales faintly yellow. It is possible to determine the section of the intestine from which the mucus is derived by the tint of this colour—the further the distance from the anus the mucus has to travel the lighter the colour.—O. Kraus, L. ii./10,95.

Detection of trypsin in the fæces to assist diagnosis of pancreatic disease. Rub up a small quantity of the fæces with Glycerin, place on a serum plate and incubate at 55° to 60° C. for 24 hours, and note occurrence of depression in the medium. The reaction is not due to Pepsin. The amount of ferment was found to be distinctly greater in loose stools or diarrhoea, indicating that probably owing to the increased peristalsis the reabsorption or destruction of ferment is hindered and an increased quantity voided.—L. i./09,184.

Formaldehyde in Urine.

We had occasion to conduct some examinations of Urine for formaldehyde to determine whether excretion of Formaldehyde occurs after administration of Hexamine and allied bodies, (*c.f.* Hexamine Vol. I., and this vol., p. 77). We found the following tests of service:—

Phloroglucin Test.

To 5 or 10 Cc. of sample add 5 drops of 1% Aqueous Solution of Phloroglucin followed by 5 drops of 30% Caustic Soda Solution. Red color appears if formaldehyde present.

Will show 1 in 2,000,000 of Water and 1 in 50,000 of urine.

(Shows no color with Hexamine.)

Rimini's Test.

To 5 or 6 Cc. of sample add 1 drop of 1% Aqueous Solution of Phenylhydrazine, then 1 drop of 1% Aqueous Solution of Sodium Nitroprusside and 5 drops of 30% Caustic Soda Solution.

Blue color appears if Formaldehyde be present.

Will show 1 in 75,000 of water and 1 in 100,000 of urine.

(Shows no color with Hexamine.)

1 in 150,000 of urine can be seen.—J. W. T. Walker, B.M.J. ii./13,654,657.

H. A. B. Dunning provides a colorimetric modification of the Phenylhydrazin Test for Formaldehyde in urine.—Am. Jl. Ph., Oct., 1913.

'Meta' Test (W. H. M.).

To 10 Cc. of sample add 0.05 Cc. of 5% Aqueous Solution of Meta-diamidobenzol Hydrochloride.

Gives a yellow color or precipitate if Formaldehyde present.

Will show 1 in 20,000 of water by color and 1 or 2 in 10,000 of urine by opalescence or precipitate.

(Gives no reaction with Hexamine.)

The 'Meta' Test in conjunction with the others may prove of value in search for Formaldehyde in Formalin poisoning, *e.g.*, with preserved milk or food.

Glucose Tests.

Sp. gr. of Diabetic Urines.

We made some experiments on this matter recently (1920) and found as follows:—

A normal urine with
Sp. Gr. 1·015 with
addition of glucose
gave Sp. Gr. Grs. as shown.

0·25%	1·017
1·0%	1·019
2·5%	1·025
3·5%	1·029
5·0%	1·034
7·0%	1·041

Laboratory Findings
with diabetic
urines (average of
some thirty specimens).

0·3%	1·007
0·83%	1·012
0·94%	1·010
1·35%	1·018
1·8%	1·025
2·0%	1·028
5·6%	1·035
6·0%	1·037
6·2%	1·042
8·5%	1·045

Taking these data into account, it is clear that it is possible to form a *rough* idea of the content of glucose (if present) from the Sp. Gr. of the specimen.

On the presence of sugar in healthy urine as a source of the Osazone Reaction.—Pavy and Bywaters, with replies by Cammidge:—

The sugar can be isolated from normal urine and confirmed by fermentation test. Directions are given for detecting by Osazone direct in normal urine. *The sugar may amount to as much as 0·25% or more in normal circumstances. The formation of osazone from a 'suspected' urine is therefore nothing more than a natural occurrence.* The Ammonio-Cupric method advised. The reducing power of Creatinine and Uric Acid is a small fraction,—about $\frac{1}{5}$ of the reducing power ordinarily met with. Difficulty of defining a 'healthy' urine under modern conditions. Sugar is acknowledged to be universally present in the blood, and hence it is argued must also be present in normal urine.—B.M.J. ii./10, 78, 176, 229, 296, 353.

Alimentary Glycosuria occurs when the limit of assimilation for the individual is reached. Breul gave 200 Gm. of grape sugar to a man and examined the urine during the succeeding 4 hours. When at rest he excreted 2·14 Gm., when at work 0·09 Gm.—Mann.

Phloridzin Glycosuria. This was first observed by Mering who by giving 1 Gm. of Phloridzin night and morning, produced the daily excretion of nearly 100 Gm. of glucose in the urine. In phloridzin glycosuria there is no increase of glucose in the blood. According to one hypothesis the phloridzin is split up in the kidneys into sugar, and phloretin. *Vide* also this vol., page 53, and Vol. I. p. 814

Renal Glycosuria is due to an abnormal excretion of the sugar normally present in the blood.

In pathological glycosuria the sugar may be formed in the system from other carbohydrates, but also from alimentary and systemic proteins and fats. Much discussion has arisen on this subject. Some claim that sugar cannot be derived from proteins containing no preformed carbohydrate molecule.

Diabetic and non-diabetic glycosuria, *i.e.*, the dangerous disease diabetes in which oxybutyric acid (*q.v.*), and its derivatives are passed, designated

' composite diabetes ' and in which coma may set in ; and the relatively harmless alimentary glycosuria have to be distinguished.—B.M.J. i./03,667 ; L. i./06,676. Significance of small quantities of sugar.—B.M.J. i./06,126.

Glycosuria in tuberculous meningitis. In 15 out of 41 cases glucose was found. It is most apt to appear in the urine during the last days of the patient's life. This variety of glycosuria has its origin in the cerebral lesions and belongs to the nervous group.—Sir A. E. Garrod, L. i./13,15.

Non-diabetic Glycosuria, Discussion on, opened by Sir A. E. Garrod.—B.M.J. ii./13,850.

DELICACY OF VARIOUS TESTS :—

Fehling's Solution will indicate	..	..	0.0008%
Trommer's	„	„	0.0025%
Nylander's	„	„	0.025%
Fermentation	„	„	0.1 to 0.5%
Phenylhydrazine	„	„	0.025 to 0.05%
Polarimeter	„	„	0.025 to 0.05%

Fungi in relation to human pathology. To detect and determine with certainty glucose in the urine an organism should be used which will split only this sugar and no other. *Monilia balcanica* will do this. Yeast is not distinctive. The urine might contain laevulose or galactose or maltose etc.—A. Castellani, L.i/20,847,895.

Fehling's Solution, Potassio-Cupric Tartrate Solution.

Glucose being an aldehyde has strong reducing action. In the test the alkaline glucose-cupric oxide when heated causes deposition of the cuprous oxide. 1 molecule of Glucose reduces as nearly as possible 5 molecules of Cupric Oxide.

In making use of Fehling's Solution it is important when looking for small quantities of sugar to dilute the urine to about Sp. Gr. 1.015. Mix with an equal volume of Fehling's Solution. Boil for a few seconds.—if no precipitate within two minutes there is no sugar of pathological import. For Life Insurance purposes the Alkaline Safranine test (*q.v.*) deserves to come more into use.

The dirty greenish yellow precipitate often formed is probably due to the Cuprous Oxide being in fine granules. Fermentation and other tests should be used in doubtful cases.—B.M.J. ii./12,1280.

Great care, however, should be taken not to confuse with reducing substances other than glucose. Personally we have great faith in Allen's modification of the test, p. 400.

Fehling's Solution is prepared in two solutions :—No. 1. Copper Sulphate 34.64, Sulphuric Acid 0.5, Distilled Water to 500.

No. 2. Sodium Hydroxide 77, Sodium Potassium Tartrate 176, Distilled Water to 500.

Mix equal volumes when required. Of this, 10 Cc. will be decolourised and reduced by 0.05 Gm. (or 53 minims = $\frac{1}{4}$ grain) of glucose or diabetic sugar in solution, with precipitation of yellowish red cuprous oxide when the two are boiled together. No. 2 solution should not be kept in a very cold place or it may crystallise. By keeping the copper solution separate from the alkaline solution the test is prevented from becoming erroneously sensitive.

A little Calcium Carbonate or Barium Sulphate greatly assists the deposition of the cuprous oxide and enables the colour of the supernatant liquor to be more easily seen.

On p. 402 we give a useful Table shewing equivalents in glucose when using **Gerrard-Fehling Solution**. The figures there given apply exactly as if 10 Cc. of 'Fehling's' are used in place of the Gerrard's Solution.

Cupric Pellets,—the salts of Fehling's Solution are prepared compressed into tablets.

Glass Capsules, containing about 1 Cc. of Fehling's Solution, are also prepared.

Glucose * Endolytic Tubes are prepared—use similar to those for Albumin *q.v.*

The reaction may be obtained in the cold or by pouring boiling water on to the charged tube (sealing is not necessary). Or, indeed, if not available a lighted vesta drawn carefully along the tube will suffice. If done in the cold, sealed tube to be inspected for usual cuprous oxide precipitate after 12 to 24 hours.

"Fehling" is reduced by dextrose, levulose, mannitose, milk sugar, galactose, arabinose, aldehyde, formaldehyde (see below), chloral, chloroform, creatinin, valeraldehyde, resorcinol, pyrogallie acid, gallotannic acid, trichloroacetic acid, arsenious anhydride, and similar reducing-bodies, glucosides, and acetone, also by

Glycuronic Acid $C_6H_{10}O_7$, =194.04, Uric Acid, Creatinine, Pyrocatechin, Hydroquinone, Salicylic Acid Compounds; these may be removed by simple repeated filtration through animal Charcoal. None of these bodies ferment or give Osazone Crystals. *Vide* Phenylhydrazin Tests.

Glycuronic Acid is closely allied to the Pentoses. It conjugates with phenol indoxyl and skatoxyl, and normally occurs chiefly as phenol-glycuronic acid in combination with potassium.—Mann.

Formaldehyde being an Aldehyde like Glucose *also reduces*,—should not be used to preserve urines for examination as to diabetes. If in doubt as to presence of Formalin for any reason boil with excess of Strong Ammonia Solution before conducting Fehling's test. Another reason for refraining from its use is that Formalin combines with Urca forming crystals on the side of the container not unlike Leucin.—B.M.J. ii./10,1164,1289,1343.

Uric Acid does not introduce any great error by its reduction of Fehling's Solution. Our experiments showed that 1% Uric Acid completely reduced an equal volume of Fehling's with about one minute's boiling. There was a slight reduction with a 0.1% solution with Fehling's but none with Nylander's reagent. 10 Cc. Fehling's (=0.05 Gm. of Glucose) by Gerrard's process required 14 Cc. 1% Uric Acid=0.14 Gram which would be equivalent to 250 Cc., Normal urine approximately which would=0.02% +error in estimating Glucose, *i.e.*, the amount is negligible. Consequently Uric Acid does not hinder the reduction of Fehling's Solution by glucose.

"Fehling" is not reduced by mannite, dulcitol, sucrose, inositol, cellulose, dextrin, arabin, alcohol, glycerin, phenol, benzaldehyde, salicyl aldehyde, acetic, lactic, oxalic, succinic, tartaric, citric, gallic, saccharic, mucic, gluconic, benzoic, salicylic, and sulphurous acids, and alkaloids.—Allen's Urine Analysis.

An orange precipitate formed when hot urine is mixed with hot Fehling's Solution without reboiling, affords almost conclusive evidence of presence of a hexose monosaccharide such as glucose or lævulose.

An orange precipitate formed on boiling is sometimes due to presence of a compound glycuronate. **To make certain of Glucose the urine must contain a + rotatory reducing substance, fermented by yeast** (both Glucose and Lævulose are), it must yield **an Osazone of the correct crystalline form, melting at slightly above 200° C** (both Glucose and Lævulose give) and finally it must yield **no Osazone** in case of Glucose **with Methylphenylhydrazine**, which with Lævulose yields one melting at 150° C.—A. E. Garrod, L. i./12,484.

Allen's modification of Fehling's Test.—For small quantities of sugar in urine. Heat 8 Cc. of the urine to boiling point and add 5 Cc. of the copper solution, cool and add 2 Cc. saturated solution of sodium acetate, slightly acidified with acetic acid, to complete precipitation of uric acid, phosphates, and xanthine. Filter, add 5 Cc. of the alkaline solution, and boil for a few seconds. If more than 0.25 per cent. of sugar be present, cuprous oxide is precipitated before boiling point is reached, but if less than this proportion, it is deposited during cooling.—Analyst, xix. 178; P.J. ii./95,307.

Carwardine's Saccharometer consists of a dropping tube graduated in percentages from 1 to 16. Urine is placed in it up to the mark "U" and diluted with water to a mark "U" (1 to 10 approx.). A volume of Fehling's Solution is measured in a measure provided and diluted with water to approximately double its volume. The diluted Fehling's Solution is then boiled in a test tube and the diluted urine gradually added until the blue colour disappears. The reading coinciding with the level of the urine remaining in the graduated tube gives the percentage.

Trommer's Test. To 5 Cc. of urine add $\frac{1}{2}$ vol. of 15% Sodium Hydrate and then 1 Cc. of 10% Copper Sulphate Solution. A red or yellow precipitate appears in the cold on standing a few hours or more rapidly on boiling. On heating much of the Cupric Hydrate may remain undissolved—an excess of alkali is necessary as in the case of Fehling's Solution (or less Copper Solution can be used). Fehling's Test has superseded Trommer's. They are employed in the same manner. Trommer's Test may be interfered with by Creatinine. H. Maclean points out the importance of adding the Alkali before the Copper Solution.—*c.f.*, B.M.J. ii./12,1280; L. ii./12, 535.

Barfoed's Reagent.—Neutral Copper Acetate (*q.v.*) 13·3, Acetic Acid solution (1 per cent.) 200. A Glucose solution warmed with a small quantity of this precipitates Cuprous Oxide.

Fermentation Test.—A useful confirmatory test. Prior to conducting, determine the specific gravity of the urine as exactly as possible. Then fill a Doremus tube completely with the specimen; place a little fresh yeast in the bend; keep in a moderately warm position for 24 hours. If sugar be present, carbon dioxide will be produced, and the gravity of the urine will fall—each degree of density lost being equivalent approximately to 1 grain of glucose per ounce.

Gerrard's Solution.

This is prepared by diluting 100 Cc. mixed Fehling Solution with about 300 Cc. of water and almost decolourising, whilst boiling, with 5% solution of Potassium Cyanide (using good commercial cyanide about 63 Cc. are required), and making up the volume when cold to 500 Cc.

For the Estimation of Sugar by this Process.—Mix 50 Cc. of the solution with 10 Cc. of mixed Fehling's Solution (5 Cc. Fehling's No. 1, and 5 Cc. Fehling's No. 2). Boil in a basin and pour into it, whilst boiling, diluted urine, $\frac{1}{2}$ to 1 Cc. at a time by means of a burette, until the blue colouration just disappears, taking care not to add an excess. An average diabetic urine may be diluted 1 with water to 10.

The calculation is then simple—as in the case of the Fehling method:—

The number of Cc. of actual undiluted urine used contains 0·05 Gm. of Glucose. From this the "percentage"—grammes per 100 Cc.—is easily obtained. To convert this into grains per fl. oz. multiply by 4·375. This product multiplied by 20 gives the number of grains of Glucose per pint. The following table will be found useful:—

No. of Cc. of diluted Urine used.				No. of Cc. of diluted Urine used.				
Gm. Sugar per 100 Cc.		Grains per fl. oz.		Gm. Sugar per 100 Cc.		Grains per fl. oz.		
		Grains per pint.				Grains per pint.		
Urine diluted 1 with Water to 10	4.0	12.5	54.69	1093.80	3.0	3.30	14.45	289.00
	4.5	11.1	48.56	971.20	3.5	2.90	12.70	254.00
	5.0	10.0	43.75	875.00	4.0	2.50	10.95	219.00
	5.5	9.1	39.86	797.20	4.5	2.20	9.64	192.80
	6.0	8.3	36.35	727.00	5.0	2.00	8.76	175.20
	6.5	7.7	33.73	674.60	5.5	1.80	7.88	157.60
	7.0	7.1	31.10	622.00	6.0	1.70	7.45	149.00
	7.5	6.7	29.35	587.00	6.5	1.50	6.57	131.40
	8.0	6.3	27.59	551.80	7.0	1.40	6.13	122.60
	8.5	5.9	25.84	517.80	7.5	1.30	5.69	113.80
	9.0	5.6	24.97	499.40	8.0	1.25	5.49	108.80
	9.5	5.3	23.21	464.20	8.5	1.18	5.17	103.40
	10.0	5.0	21.90	438.00	9.0	1.11	4.86	97.40
	10.5	4.8	21.02	420.40	9.5	1.05	4.60	92.00
	11.0	4.5	19.71	394.20	10.0	1.00	4.38	87.60
11.5	4.3	18.83	376.60	10.5	0.95	4.15	83.00	
12.0	4.2	18.40	368.00	11.0	0.91	3.96	79.20	
12.5	4.0	17.52	350.40	11.5	0.87	3.81	76.20	
13.0	3.8	16.61	332.20	12.0	0.83	3.64	72.80	
13.5	3.7	16.21	325.20	12.5	0.80	3.50	70.00	
14.0	3.6	15.77	314.40	13.0	0.77	3.37	67.40	
14.5	3.4	14.86	297.20	13.5	0.74	3.24	64.80	
				14.0	0.71	3.11	62.20	
				14.5	0.69	3.09	61.80	
				15.0	0.67	3.00	60.00	

Cambridge's Modified Benedict (Qualitative) Test for Quantitative Estimation. (*Distinguish carefully from both the foregoing.*)

Dissolve by aid of heat Sodium Citrate and Crystallised Sodium Carbonate of each 200 Gm., Sodium Bicarbonate 10 Gm. in about 600 Cc. of Distilled Water, and add to this with constant stirring a solution of 21 Gm. Crystallised Copper Sulphate in about 150 Cc. of water. When cold make up to 1000 Cc.

This solution is about ten times as sensitive as Fehling's Solution, so that a very *small proportion* of urine gives an unmistakable reaction even with a low percentage of sugar, and it is not appreciably reduced by Uric Acid, Creatinine, etc.

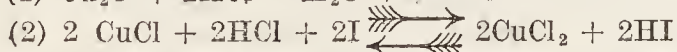
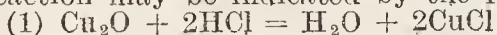
It is employed instead of Fehling's Solution in a modification of **Scales' Volumetric Method** for estimation of Sugar in urine and blood.—P. J. Cambridge, L. i./17,613.

Method of procedure:—

The estimation is conducted by boiling a given quantity of the urine with a given quantity of the solution, hydrochloric acid is added to dissolve the cuprous oxide. It also liberates carbon dioxide which protects the cuprous chloride from atmospheric oxidation. The cuprous chloride solution is added to a given quantity in excess, of standard volumetric N/10 iodine solution and the excess of iodine is titrated with N/20 thiosulphate (the official N/10 will do equally well), using starch as indicator.

Each Cc. of N/10 Iodine Solution = 0.00338 Gm. Glucose.

The reaction may be indicated by the following:—



R. W. Garrow, P.J.i./18,148, draws attention to the accuracy of the method:—It is important that the titration of the excess of Iodine be done rapidly. If there is any delay in taking the burette reading when first the iodo-starch colour vanishes, confusion will follow.

We have tried the process firstly on a 0.5% Solution of Glucose and secondly a 5% solution.

(1) 5 Cc. of 0.5% solution of glucose were boiled for 15 minutes with 20 Cc. of the modified Benedict's reagent. Then dilute hydrochloric acid *q.s.* was added to dissolve all the cuprous oxide formed. N/10 iodine solution 20 Cc. were added and titrated back with N/10 Sodium Thiosulphate using starch as indicator. 12.9 Cc. of the latter were required, *i.e.*, volume of N/10 iodine decolorised = 7.1 Cc., therefore 5 Cc. of the 0.5% glucose solution contain (0.00338×7.1) Gm. = 0.023998 Gm., *i.e.* 0.47996% glucose. On repeating, 0.49354% glucose was found.

(2) Operating on a 5% solution 1 Cc. was boiled for 15 minutes with 40 Cc. of the reagent, hydrochloric acid added and 20 Cc. N/10 iodine. For back titration 5.5 Cc. N/10 thiosulphate were required, *i.e.* 14.5 Cc. N/10 iodine were decolorised, *i.e.* 1 Cc. of the solution under test contains 0.04901 Gm. glucose or 4.901% glucose.

We found there is considerable difficulty in determining the end point in the titration with thiosulphate, as the weak solution of cupric chloride formed is also a blue colour. Contrary to Garrow (*loc. cit.*) we found no white precipitate forming. The solution remains perfectly clear during the whole of the titration.

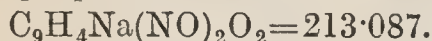
Gowers' Test. *Syn.* Moore's Test for roughly estimating glucose :—

Dilute with an equal volume of Liquor Potassæ, this makes all urine pale enough to prevent important error in such a rough test. Boil the upper half well but not too long—a lemon tint corresponds to about 5 grains per fluid ounce, a pale sherry to 10 grains, a dark sherry to 15 grains, and a port wine tint to 20 grains and upwards.

Parnell's Clinical Test. This consists in boiling equal volumes of the specimen and Liq. Potassæ and comparing the tint with coloured glasses.—B.M.J. ii./14,12,564; i./15,419; i./17,842. At the time of going to press the colour scales were not available.

A. F. Dimmock (B.M.J. ii./14,399) proceeds as follows :—

To 20 Cc. of the urine, diluted twenty times with distilled water, 10 Cc. of a filtered solution of potassium carbonate (1 in 4) is added, and this is boiled carefully for three minutes, cooled, and made up to, say, 50 or 100 Cc. with distilled water. A solution of glucose is prepared, 1 Gm. in 200 Cc. of distilled water; 20 Cc. of this and 10 Cc. of the potassium carbonate solution are boiled in a flask for three minutes, and when cool made up to 50 or 100 Cc. The two solutions are then compared in glass tubes, as in nesslerising. By adding the known solution until the tints are alike and noting the amount used, the percentage can be calculated.

Johnson's Test.—See Picric Acid, p. 405.**Nitropropiol. Sodium. Orthonitrophenylpropiolate.**

Owing to reduction, Indigo blue colour is produced, or indigo-blue itself precipitated. Tablets are prepared. This reaction is based upon Bayer's synthesis of indigo-blue (*q.v.*), which is briefly :—Cinnamic Acid \rightarrow Orthonitrocinnamic Acid \rightarrow Dibromo compound of \rightarrow Orthonitrophenylpropionic Acid, which, warmed with alkali, in the presence of Glucose decomposes thus :— $2\text{C}_9\text{H}_5(\text{NO}_2)\text{O}_2 = \text{C}_{16}\text{H}_{10}\text{N}_2\text{O}_2$ (Indigo Blue) + $2\text{CO}_2 + \text{O}_2$. This substance is to be distinguished from Sodium phenyl-propiolate (*Syn.* Thermiol). For testing permeability of the kidney with Indigo-carmin. *v.* p. 53.

Sodium o-Nitrophenylpropiolate Solution is employed of following composition : Place 5 Gm. of o-nitrophenyl-propionic acid in a mortar and wash alternately with 1 to 2 Cc. of water and 1 to 2 Cc. of 10% Sodium Hydrate Solution until dissolved (altogether about 8 to 10 Cc. required). Dilute to 1 litre. On boiling 5 Cc. with 1 Cc. of Urine blue colour of indigo appears either immediately or in $\frac{1}{2}$ minute according to amount of glucose.

Nylander's Reagent.

Bismuth Subnitrate 2, Rochelle Salt 4, Sodium Hydroxide Solution (8%) 100; and **Almen's** re-agent consisting of Bismuth Subnitrate 1, Rochelle Salt 2, Potassium Hydroxide Solution (35% strength) 50, are used for detecting Glucose. A small quantity of either warmed with the urine will blacken if glucose be present.

This reagent is not interfered with by the presence of Uric Acid. Even a 1% Solution of the acid we found failed to produce any appreciable reduction on boiling 5 minutes.

Cramer's Mercury Test.—Dissolve Mercuric Oxide (red or yellow) 0.4, with Potassium Iodide 6, in water 100 and adjust alkalinity of the solution so that 10 Cc. are neutralised to phenolphthalein by 2.5 Cc. of N/10 Acid.

To use the test heat 3 Cc. of the test to boiling and add 0.3 Cc. of Urine and boil again. On removing from flame the mixture darkens if sugar is present. Metallic Mercury settles ultimately. Glucose, lactose, maltose, xylose and arabinose give the reaction, but not cane sugar.—Biochem. Jl., March 1915, L. i./15,1192.

Our experience with the test (1920) is that it is quite sensitive. The deposit of metallic mercury is of a greyish colour.

Phenyl-hydrazine Hydrochloride, $\text{C}_6\text{H}_5\text{NH.NH}_2.\text{HCl} = 144.582$. Is used as a test for sugar. It is in colourless, shining, crystalline scales; and should be free from azo-compounds. A small quantity is warmed with twice its weight of sodium acetate in solution, an equal volume of the suspected solution added, and boiled for 20 minutes. On cooling, yellow crystals of phenyl-glucosazone, $\text{C}_6\text{H}_{10}\text{O}_4 \cdot \text{N}_2\text{H.C}_6\text{H}_5)_2 = 358.806$ are deposited if sugar be present.

This substance should be handled with care as it may produce eczema.

Boil 2 to 3 Cc. of the urine with equal quantity of water and phenylhydrazine hydrochloride 0.1 Gm. and Sodium Acetate 0.5 Gm. Add 10 Cc. of Sodium Hydrate 10% solution, invert test tube a few times and allow to stand. A pink to red colour of the whole liquid in 5 minutes indicates sugar of clinical significance.

Picric Acid. JOHNSON'S or BRAUN'S TEST. This has been suggested as a test for Glucose in urine, as a solution of this sugar, if boiled with Picric Acid and Solution of Potash, reduces the yellow Picric Acid to the deep red Picramic Acid. $C_6H_2(NO_2)_3OH + 9H_2 = C_6H_2(NH_2)_3OH + 6H_2O = 139.132$ forming Potassium Picramate the depth of colour depending on the amount of sugar. By the aid of **Johnson's Picro-Saccharometer** this reaction is made a quantitative test.

Solution for use with same: Strong Solution of Ferric Acetate (B.P. '85) 15 drachms, Glacial Acetic Acid $7\frac{1}{2}$ ounces, Ammonia Solution 0.959, $3\frac{3}{4}$ ounces Water to 3 pints.

Safranine Solution.—1 in 1,000. One volume of this, with one of urine and one of liquor potassæ is heated to boiling, avoiding agitation. If the urine contain sugar to the extent of 0.1% the liquid will be decolourised. (On cooling colour may return in proportion to the amount of sugar present.) Each additional volume of the safranine solution that may be decolourised represents roughly 0.1% of sugar.

Safranine Solution (unlike Fehling's Solution) is unaffected by Creatin, Creatinine, Uric Acid and Urates. The test deserves to be better known. *We find it satisfactory employing the brand of Safranin known as Safranin 'O.'* It is only slowly affected by albumin.

Hyperglycaemia and Glycosuria.—H. J. Hamburger, B.M.J. i./19,267.

Lævulose reduces Fehling's Solution, ferments with yeast, forms an osazone with Phenylhydrazin like glucosazone. *Vide also Org. Anal. Chart.* Occasionally found in urine alone—more commonly with dextrose.

Pseudo-Lævulose of diabetic and other urines. True lævulosuria or fructosuria may be met with, but it is apparently rare. The lævo-rotatory body is in reality the ketonic acid, isoglycuronic acid which is differentiated from Lævulose by Borchardt's test—the acid is precipitated from an acid solution on saturation with Lead Acetate and the melting point of the para-bromphenylosazone. Specimens from 30 cases of so-called lævulosuria and 50 of diabetes in which a lævorotatory substance was present along with Dextrose were examined and in none could any true lævulose be found.

Borchardt's Modification of Seliwanoff's Test consists in treating the specimen with Hydrochloric Acid and Resorcin, making alkaline with Sodium Carbonate and extracting with Ethyl Acetate. With *plant* lævulose the extractive is red in colour, but with urines giving the ordinary Seliwanoff Reaction the watery solution retains the pigment and the extract is yellow.—P. J. Cammidge and H. A. H. Howard, L. i./15,329.

Seliwanoff's Reaction for Lævulose. On warming a solution of Resorcin in 1 part of concentrated Hydrochloric Acid and 2 parts water with Lævulose an intense red coloration is formed and gradually a dark precipitate soluble in Alcohol with a red colour. Glucose, Lactose, Maltose and Pentoses do not give this colour.

Seliwanoff's Reaction for Cane Sugar. The test applied exactly as above gives only a very faint pink on warming. Takes some minutes to form. Using strong hydrochloric acid, the reaction for both is the same. The precipitate in both cases is soluble in alcohol.

Alkaptonuria (rare), due to presence of Di-oxyphenyl-acetic Acid $C_6H_3(OH)_2CH_2.COOH = 168.104$. Urine reduces Fehling's Solution, and turns brown with alkali. See also Mann *q.v.* also for ochronosis and melanuria.

A case.—L. i./07,660. Of 31 cases of alkaptonuria 15 were in children of first cousin marriages.—Sir A. E. Garrod, L. ii./08,5.

Alkaptonuria occurring with pityriasis rubra.—P.R.S.M. Derm. Sect. March, 1910, p. 60.

Pentose.

Bial's Test (P.G.V.)—Orcin 1 Gm. in 500 Cc. of Concentrated Hydrochloric Acid containing 25 drops of Ferric chloride Solution.

Method of use.—4 Cc. are heated in a test tube to boiling—then add not exceeding 1 Cc. of the specimen. If pentose present, green colour either at once or shortly. Glycuronic Acid does not interfere.—Mann.

For quantities less than 1% the mixture should be heated in a water bath at 96° C. for two minutes, by this means 0.1% or less can be detected (must not be over heated). We found normal urines with these conditions may give a dull olive green colour, therefore one should test a normal urine alongside.

Pentose reduces Fehling's Reagent but is not fermentable. It occurs after excess of fruit such as plums and cherries. Pathologically it occurs in morphia habit.

NOTE.—Orcin. *Syn.* Methyl Resorcin. Dioxytoluol 1 : 3 : 5 $C_6H_3(CH_3)(OH)_2 + H_2O = 142.115$. White crystals turning pink. Very soluble in water and alcohol. Has antiseptic properties but used mostly as test.

Orcein.— $C_{28}H_{24}N_2O_7 = 500.352$. Prepared from the above. Red dish powder, soluble in Alcohol with red colour with violet colour in alkalis used as mordant in flagella staining and for demonstrating elastic tissue in sputum.

Pentosuria.—L. ii./19,117.

Glycerin.

Glycerin in the urine is claimed to be indicative of pancreatic disease, and to result from the decomposition of fat. Cammidge's Reaction depends on the formation of crystals with phenylhydrazin, *vide* L. i./04,783; L. i./05,14; L. ii./05,1824.

The characteristic needle-shaped crystals can be obtained from the urine in pancreatitis. acnte and chronic. In malignant disease they are found only in about a quarter of the cases, and in these a zone of inflammation probably surrounds the cancerous area.—B.M.J. ii./09,937.

Taken in conjunction with clinical symptoms the reaction gives a trustworthy diagnosis of pancreatic disease.—P. J. Cammidge.—B.M.J. ii./10,8. See also chronic pancreatitis with special reference to diagnosis and treatment.—L. i./11,1494. P.R.S.M. Med. Section, 1910, p. 163. See also Path. Sectn., Feb. 1910, p. 79. *c.f.* also Adrenalin Test, page 153.

Blood and urine examination in pancreatic disease.—P. J. Cammidge and co-workers.—L. ii./20,393.

Hippuric Acid.

Syn. Benzoyl-glycocoll, *vide* Vol. 1, p. 8.

Hippuric Acid is excreted daily to extent of about 0.5 to 1 Gm. on mixed diet or it may reach 2 or 3 Gm. on vegetarian diet. It is formed by the interaction of dehydrated Benzoic Acid and Glycocoll in the system. Protein in the intestines produces amino-acids which are oxidised to benzoic acid. **Glycocoll** is a normal product of metabolism, and by this reaction renders the benzoic acid (*inter alia*) harmless,—this occurs, it is thought, in the kidneys.

1 of the free acid in 55,000 of water will change Congo red paper to blue, but urine does not cause the change—showing that the Hippuric Acid that is present is in the combined condition.

Hippuric Acid Estimation.—Heat 100 Cc. of urine with 10 Gm. Sodium Hydrate in a Kjeldahl flask with reflux condenser 2½ hours. Then add Potassium Permanganate 10 Gm in small portions and heat gently for 5 to 7 minutes. The liquid remaining at least pink, cool, add small pieces of ice then Sodium Bisulphite 15 Gm. Still keeping the liquid cool add Sulphuric Acid 1 : 2 *g.s.* to acidify. Shake out five times with Ether. The residue after distilling off the Ether is shaken out with Chloroform. This dissolves out the Benzoic Acid formed. Evaporate and weigh. Multiply resulting acid by 1.468 to obtain quantity of Hippuric Acid.—T. H. yntschak, Y.B.P., 1913, 56.

Indican.

Indican, Potassium Indoxyl Sulphate, $C_8H_6NSO_4K = 251.258$ may be detected by **Ehrlich's Test**: a Solution of 0.33 Gm. of Dimethyl amidobenzaldehyde in water and strong Hydrochloric Acid of each 50 Cc.

Boil the urine with an equal quantity of this solution. Cool and render alkaline with Ammonia or weak Potash Solution. If Indican be present a red colour results.

Jaffe's Test.—Indican may also be detected by adding to the specimen an equal volume of strong Hydrochloric Acid, and adding drop by drop carefully (not in excess), concentrated Liquor Calcis Chlorinata; blue colouration, due to Indigo, if Indican present, which may be taken up by shaking with Chloroform. If shaken with Ether this solvent will dissolve the Indigo-red.

In the case of a patient treated with Iodides, the chloroform is almost certain to be violet; add a crystal of sodium hyposulphite to prevent confusion.

Permanganate Test.—To a mixture of 10 Cc. of urine and 10 Cc. of Hydrochloric Acid (Concentrated) add 3 drops of 0.5% Potassium Permanganate Solution. If Indican present a purplish cloud is formed. Add one or two drops of Chloroform, then one or two more drops of Permanganate and a few more drops of Chloroform or a total of 5 Cc. of Chloroform. Shake vigorously a few seconds. The purplish colour is replaced by a deep blue—Indican dissolving in the Chloroform. The intensity of colour shows extent of intestinal putrefactive changes.—W. H. Porter (*c.f.* Chologestin, *Vol. I.*, p. 620)

Indol—in fæces. The Dimethylamidobenzaldehyde test for Indican is indicative of Indol. Indican is formed from Indol.

For the Indol Reaction in Water Examination, see Water, Bacteriological Examination.

Indoxyl. $C_8H_5(NH)OH = 133.106$.

Add an equal volume of hydrochloric acid. Shake and add a drop or two of sodium hypochlorite solution. Blue colour appearing indicates presence. May be shaken into a small quantity of chloroform to render more evident.

When Indican is found in the urine there is evidence of albuminous decomposition, and in cases of indigestion this is most frequently the result of putrefactive changes in the small intestine.

Lead and Other Metals.

LEAD IN THE URINE IN TRENCH NEPHRITIS. The incidence of the disease suggested the possibility of its being attributable to the use of tinned foods. Both lead and tin were found in specimens. Incidentally copper is stated to be a normal constituent of the tissues. Some useful data are included, giving the best methods of search for *metals in urine*.—C. D. White, *L. i.*/16, 996.

Nitrogen.

The quantity in Urine is approximately 0.9% as an average—(90% of this is in the form of urea).

Determination.—Heat 25 Cc. in porcelain basin with 10 Cc. of strong Sulphuric Acid until volume reduced to about 10 Cc. Finally, add about 5 Gm. of Potassium Sulphate to the residue in a flask in inclined position with small funnel in neck to act as condenser. Heat until colourless; cool and add very cautiously 20 Cc. water drop by drop, and introduce with utmost care a strong solution of Caustic Soda to alkalinity, for Kjeldahl method by distillation into a known quantity of Standard Acid and ultimate back-titration with alkali, or to near neutralisation by this modified method. Make up volume to 100 Cc.; take of this 10 Cc. = 2.5 Cc. of original urine, and treat this quantity with Hypobromite in a Doremus or other form of Urea Apparatus.

In this way 24 Cc. of moist Nitrogen = approx. 0.028 Gm. Nitrogen or

= 0.034 „ Ammonia.

= 0.06 „ Urea.

When output of Nitrogen exceeds intake—tissue breakdown is in excess of reconstruction. When active reconstruction is in progress the intake of nitrogen exceeds output in the urine and fæces. An even nitrogen balance may be maintained upon diets of a very different protein content, also upon a diet much poorer in protein than that usually taken by healthy men, but it does

not follow that the reduced diet is an optimum diet—more probably we need habitually excessive quantities of food proteins to get from our diet all we need of each individual fraction of the protein molecules.—Sir A. E. Garrod B.M.J. i./11, 1413.

PERNICIOUS VOMITING OF PREGNANCY. Toxæmic form characterised by marked distortion in the nitrogenous partition—in particular by an increase in the proportion of total Nitrogen excreted as Ammonia.

This so-called ammonia co-efficient, which in normal pregnant women varies between 3 and 5 per cent., may become markedly increased, rising in one case to as high as 48 per cent. The significance of a high ammonia co-efficient is not specific. It may be a manifestation of toxæmic vomiting, of starvation following neurotic vomiting, or of an acidosis due to various causes. It should be regarded as a danger signal.—J. W. Williams, Glas. Med. Jl., Dec., '12.

The **Hexamine method** of Titration is recommended to obviate the distillation of the Ammonia in the Kjeldahl process. The acid is neutralised to Methyl Orange with Sodium Hydrate Solution, CO_2 is boiled off, excess of Formaldehyde Solution is added and the free acid is titrated with standard Sodium Hydrate solution using Phenolphthalein as indicator. The acid set free by the Formaldehyde is a measure of the Ammonia and consequently the Nitrogen. The process is recommended for the estimation of various Ammonium Salts.—G. Simpson, P.J. i./14, 546.

Lime Fusion Method of Estimating Nitrogen. Place 2 Cc. urine and a few Gm. of pure Calcium Oxide in a quartz test tube, connect in a suitable manner with a receiver containing 20 Cc. N/10 Hydrochloric Acid and distil the urine into it until the contents of the test tube are heated to redness. The amount of acid neutralised indicates the amount of Nitrogen present.—M., 1912. This would appear a practicable method.

Folin and Denis' Method of Estimating Total Nitrogen.

Modified Nessler Reagent—Folin and Denis criticise the composition of Nessler's Reagent as being excessively alkaline and containing too little Potassium Iodide. They dissolve Potassium Iodide 75 Gm. in warm water 50 Cc., add Mercuric Iodide 100 Gm. and stir. Dilute with water 400 or 500 Cc., filter and make up to 1 litre. To 300 Cc. of this Double Iodide solution add 200 Cc. of 10% Sodium Hydroxide, 500 Cc. of water and mix. This final solution contains 2% Sodium Hydroxide, which is preferable for Nesslerising Digestion Mixtures of samples of Urine.

15 Cc. of this modified Nessler's Reagent added quickly to the digestion mixture will yield *clear* mixtures with as large amounts of ammonia as are met with in the method (0.7 to 1.6 mgr. Ammonia-Nitrogen).

They dilute their digestion mixture (obtained by digesting 1 Cc. of Urine in a mixture of Sulphuric Acid 100 Cc. and Phosphoric Acid 85% 300 Cc. and 25 Cc. of 10% $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in hard glass test tubes or Silica tubes) to 100 Cc.

Stock Standard Ammonium Sulphate Solution is made with specially purified Ammonium Sulphate 4.716 Gm. per litre = 1 mgr. Nitrogen per Cc. A weaker solution 1 mgr. = 20 Cc. is made for general use.

Duboseq's Colorimeter is used. The Urine if necessary is diluted so that it contains from 0.7 to 1.5 mgr. of Nitrogen.

With an Ostwald Pipette measure 1 Cc. of the Urine and add 1 Cc. of the Phospho-Sulphuric mixture (above) and digest until the dense Sulphuric Acid fumes start to come over—in 2 to 5 minutes. Allow to cool and make up to about 150 Cc. with water. Titrate with 10% NaOH using phenolphthalein. Add to the diluted mixture 10% NaOH in amount equal to $\frac{1}{8}$ times the titrating value obtained plus an excess of 2 Cc. for alkalinity. In another flask place 1 Cc. of the concentrated acid mixture, and 20 Cc. of the Standard Ammonium Sulphate solution, add about 125 Cc. of water and the same amount of Sodium Hydroxide as in the case of the specimen under examination. Then add to each 15 Cc. of Nessler Reagent. Make up to the 200 or 250 Cc. and mix. Centrifugalise, filter through cotton and compare with the colorimeter.

A series of results with corresponding data obtained by Kjeldahl's method shows little difference.—O. Folin & W. Denis, Jl. Biolog. Chemistry, 1916 p. 473 *et seq.*

Non-Protein Nitrogen in Blood.

Meta-Phosphoric acid is employed as *protein* precipitant. (Glacial Phosphoric Acid, a commercial brand containing HPO_3 and NaPO_3 , is spoken of.) It is very effective as a precipitant of blood proteins, the filtrate being perfectly clear.

Solutions of *m*-phosphoric acid must not be old, as the acid changes in time to *o*-phosphoric acid, which does not precipitate proteins. The variety in sticks is preferred by the authors; 5 Cc. of 25% solution is adequate for precipitating 10 Cc. of blood.

The procedure is as follows:—

To about 20 Cc. of water in a 50 Cc. graduated flask add 5 Cc. of blood, then 3 Cc. of the 25% *m*-phosphoric acid, mix, allow to stand for 1 to 24 hours, fill up to mark and filter. If desired make up to volume at once instead of allowing to stand. Transfer 10 Cc. of the filtrate (= 1 Cc. of blood) to a hard glass tube (190 mm. \times 13 to 15 mm.). Add a piece of granite to prevent bumping and 1 Cc. of the acid mixture (Sulphuric Acid 100 Cc., Phosphoric Acid 300 Cc. and 25 Cc. of 10% Copper Sulphate solution) as used for destructive digestion of Urine, *antea*.

Boil off the water and complete the digestion, allow to cool 2 minutes, add water and rinse contents into a 100 Cc. graduated flask, using 60 to 70 Cc. of water in all.

Neutralise by adding $\frac{1}{8}$ times the amount of 10% NaOH indicated by the titrating value of the phosphoric-sulphuric acid mixture plus 1 Cc. for alkalinity.

Cool and add 10 Cc. of the modified Nessler reagent. Mix, centrifuge and compare with Standard Nesslerised Ammonia Solution as under Urine.

The standard should usually consist of 0.5 mgr. ammonia nitrogen plus 1 Cc. of the phosphoric-sulphuric acid mixture diluted, neutralised, cooled and Nesslerised as in the case of the specimen.

In a series of determinations cited the non-protein nitrogen ranges from 24 to 66 mgr. in 100 Cc. of blood.—O. Folin & W. Denis, *Jl. of Biolog. Chemistry* 1916, p. 491 *et seq.*

(This method supersedes the author's process described in the *Jl. of Biolog. Chemistry*, 1912, XI., p. 527.)

See also Urea.

Ammonia.

In urine may be estimated by distillation and Nesslerisation of the distillate or by aid of Volumetric Acid, as above.

The average amount of total ammonia in urine is 0.30% by weight.

Ammonia excretion varies during 24 hours—it is greatest during the night. Bodily exercise by producing acids increases output as also does consumption of fat (usually seen after interval of 1 to 2 days).

In fevers, malignant disease, diseases of the liver, ammonia is increased. In pernicious anæmia the amount may be considerably above or it may be rather below the average.

Malfatti's Method, using the formation of hexamine from formaldehyde and ammonium salts, is favoured:—

Add to urine 25 Cc., in a 250 Cc. conical flask, water 50 Cc., and 4 drops of alcoholic phenolphthalein solution 1%. N/10 sodium hydrate solution is added to neutralization, which also gives the amount of acidity. 5 Cc. of 40% Formalin, neutral to phenolphthalein, is added and the titration continued until the pink colour reappears. From the number of Cc. used in the second titration the amount of nitrogen present as ammonia in the twenty hours' urine can be readily calculated. Better colour changes are stated to be obtained if 15 Gm. of potassium oxalate is added to the urine two minutes before titrating. The results obtained by this method are usually somewhat too high.—*B.M.J.* i./09, 715.

It has been pointed out that there is a marked increase in the proportion of Ammonia to total Nitrogen—it may rise from the normal proportion. 3 to 5% up to even 45%, of the total Nitrogen—in women suffering from pernicious toxæmia. Vomiting of pregnancy indicates the existence of a serious toxæmia, which, if permitted to continue, will be found to be accompanied by lesions of the liver and other organs, inconsistent with life. A coefficient of 10% is stated to be a danger signal

In the course of a case of diabetes, late in which disease the diurnal excretion of urea is usually increased, there is a drop in the quantity excreted and a corresponding rise in the ammonia salts, this is an evil omen—probably a warning of acid intoxication and therefore of coma.

Folin and Denis' Method.

The great obstacle in the way of determining the Ammonia in Urine by direct Nesslerisation is the strong reducing effect of Urine on alkaline solutions of Mercuric salts—mainly due to creatinine. The Mercury of Nessler's Reagent is speedily reduced to metallic Mercury. Though small in say 1 to 3 Cc. the amount is sufficient to cause turbid suspensions—in this case of Mercurous Oxide.

Pure Blood Charcoal removes 90% of the creatinine without absorbing the Ammonia. It also takes up Uric Acid and phenols.

To 10 Cc. of Urine in a large test tube or small flask add 1 Cc. 25% *m*-Phosphoric Acid, 9 Cc. of distilled water and 2 Gm. blood charcoal. Shake 1 minute and filter. Place 1 to 5 Cc. of the filtrate in a 100 Cc. graduated flask, add distilled water to about 70 Cc. Nesslerise with the special reagent (*vide* Total Nitrogen, *antea*). Compare with 1 mgr. of ammonia nitrogen in another 100 Cc. flask.

This method supersedes and does away with the aeration method.

A series of cases showed:—

In Normal Urine (5 cases) 0.37 to 1.27 Gm. Ammonia Nitrogen per litre.

In diabetic specimens 0.98 to 4.0 (7 cases).

In nephritic specimens 0.21 to 0.93 (3 cases).—O. Folin & W. Denis, *Jl. Biolog. Chemistry*, 1916, p. 497 *et seq.*

Peptones. See Albumoses.

Phosphates in Urine.

(Mean content is 0.15 to 0.2% P_2O_5 .)

These are estimated by means of a **Standard Uranium Nitrate Solution**, prepared by dissolving 35 Gm. of the Nitrate in 900 Cc. of water, and standardising it against 50 Cc. of a solution of 5.042 Gm. of pure Sodium Phosphate (*Off.*) in 1 litre of water 5 Cc. of a solution of Sodium Acetate 100 Gm., with 100 Cc. of Acetic Acid in water *q.s.* to 1 litre is added, both in standardising and in the estimation of the sample of urine. A few small crystals of Potassium Ferrocyanide on a white tile serve as an indicator; the Uranium Nitrate Solution being added to the *hot* Standard Phosphate Solution (or the specimen) until a drop removed by the aid of a rod commences to cause a brownish precipitate with them. This amount of the Uranium Nitrate Solution corresponds to 0.05 Gm. P_2O_5 . The solution may either be diluted so that 10 Cc. shall be equivalent to this quantity (1 Cc. of the Uranium Solution = 0.005 Gm. P_2O_5), or better, its strength may be noted and verified from time to time; 50 Cc. of the Urine is the quantity taken for examination, the conditions being the same as above.

Or the Phosphate Solution may be run into the Uranium—the end reaction being clearer, the disappearance of the brown colour is more easily visible than its formation.

Organically Combined Phosphorus is in addition present in urine. The daily average is stated to be 11 to 28 mgr. About $\frac{1}{3}$ of the total ingested Phosphorus is excreted by the bowels.

Lime taken in large amount, either apart or in food, causes the Phosphoric Acid in the urine to diminish—(insoluble) Calcium Salts being excreted in the faeces.

The excretion of Phosphoric Acid is increased by the ingestion of small quantities of **Nucleinic Acid**. On a fixed diet for two periods of 8 days the N : P_2O_5 quotient, during one of the periods without Nucleinic Acid was 5.12 to 1, whilst in the other in which Nucleinic Acid was given, the proportion was 3.7 to 1. (The normal is about 5 or 6 to 1. P_2O_5 is not furnished by ordinary proteins but by tissues rich in nuclein.) But administration of (Mineral) Metaphosphoric Acid did not give a P_2O_5 increase in the urine corresponding to the amount given.

In human milk the combined P is 4.15% of the total it contains; in cows' milk it is only 6%. N to P_2O_5 in the former is 3.3 to 1 and in the latter, 2.3 to 1, yet the urine of the child at the breast gave ratio 7 : 1 whilst when fed

by hand it was 1.7 : 1, *i.e.* organically combined phosphorus is retained. Organically combined phosphorus in the urine is probably derived from metabolism of the nuclein containing tissues and not influenced by ingestion of food rich in nuclein—feeding experiments confirm this.—Mann. *q.v.* also for causes of increase and decrease of Phosphoric Acid in the urine in disease.

Joulie's Ratios.

The so-called alkalinity of the blood is due to the presence of Bicarbonates which are chemically Acid Salts, so that in spite of the alkalinity to litmus the blood may according to Joulie be viewed as an acid fluid. The acidity due to Sodium Acid phosphate is masked by the excess of the Bicarbonates. The blood contains in solution Calcium Phosphate and Magnesium Phosphate, and seeing that these are precipitated in alkaline or even faintly acid solution, this is considered another point in favour of the view that blood is acid in reaction. Bicarbonates are practically absent from the urine. A treatment has been evolved based on determination of the acidity of the urine (according to Joulie, due to Sodium Acid Phosphate) by adding standardised Calcium Saccharate Solution. This acidity shall thence be an index of the acidity of the blood. A precipitate is formed of Tri-Calcium Phosphate which re-dissolves, forming Mono-Calcium Phosphate so long as there is a sufficiency of the Acid Phosphate to combine and produce the soluble Mono-Calcium Phosphate.

Joulie compares the degrees of acidity of urines for equal amounts of Solids in specimens as indicated by the increase in Specific Gravity over that of water, and expresses the result in percentage, *e.g.*, if the Sp. Gr. be 1.015 and we find acidity 0.505 (in terms of H_2SO_4 per litre), then an excess of density equal to 100 would give

$$\frac{0.505 \times 100}{15} = 3.36 \text{ as Ratio of Acidity ('R.A.').}$$

It is then obviously possible to find a Urine with Specific Gravity lower, *e.g.*, 1.005, showing a lower acidity per litre, *e.g.*, 0.308, which is in reality more acid when we eliminate the increase of water—thus

$$\frac{0.308 \times 100}{5} = 6.16 \text{ as Ratio of Acidity.}$$

The determination of acidity per litre is, therefore, considered fallacious. The average R.A. in health is 4.55. A ratio above is hyper-acid, and below is hypo-acid. The latter condition is much more common, due to failure of hepatic function.

In vegetarian diet the excess of alkalis appearing as Carbonates in the urine will produce an alkaline reaction.

To relieve the hypo-acidity with the resultant pathological deposition of lime salts, and the production thereby of phosphatic gout, it is suggested to administer dilute Phosphoric Acid. (Other Acids would have the same effect but they coagulate Albumin and are not well tolerated by the stomach. Phosphorus exists as Calcium Phosphate in the bones, Sodium Phosphate in the plasma, Potassium Phosphate in the nervous system, in combination with Iron in the red blood corpuscles, and as Magnesium Phosphate in the muscles.)

The daily total average loss of Phosphoric Acid is estimated at 3 Gm. in the urine and 1.5 Gm. in the faeces—total 4.5 Gm.

To raise the acidity of the urine (and hence of the blood as Joulie claims) large amounts of Phosphoric Acid have to be given.

Sodium Acid Phosphate would be indicated where there is deficiency of H_2PO_4 accompanied by a mild hypo-acidity—usually up to 5 Gm. per diem is given.

The Ratio of Phosphoric Acid (R.P.) to excess of density of urine over water is as an average 11 to 11.5. If above this, the condition is called hyper-phosphatia

Normally $\frac{R.P.}{R.A.} = 2.45$ (Joulie's co-efficient or Acido-phosphoric ratio).

Phosphatia*, according to Joulie, generally indicates that the R.P. is abnormal. If *excessive*, is treated by diet rich in phosphates—gruyere cheese, haricot beans, mutton, beef, white cheese, eggs, cereals, milk (enumerated in

*PHOSPHATIA is applied to a condition of abnormal amount of phosphates and requires the prefix hyper or hypo to indicate excess or deficiency.

order of preponderating percentages). If R.P. *deficient* this means excessive phosphoric excretion has *preceded*, therefore also administer phosphates; the kind of Phosphate to give depends on the R.A.

If the R.A. is *normal*, a neutral phosphate must be given. **Sodium Sesquiphosphate** as described Vol. I., p. 709, has been suggested and is specially prepared.

Hyper-acidity will rapidly yield to the ordinary Sodium Phosphate, *e.g.*, in the form of Effervescent Sodium Phosphate.—Abstracted from a paper read at the London Homœopathic Hospital, December 5th, 1907, and Jan., 1908.

Pleural and Peritoneal Fluids, Examination of.

Physical Characters.

Colour.—Note whether blood stained or not. (Caution: A small amount of blood may get into the fluid in the process of exploring.)

Observe whether transparent or otherwise.

Test for fat.

Consistence, Sp. Gr., odour, amount and nature of deposit are stated.

Chemical investigation will give:—

(1) Reaction, (2) Presence of serum albumin and serum globulin, (3) Presence of Mucin or Nucleo-albumin by addition of Acetic Acid, (4) Sugar, (5) Urea for which the fluid must be concentrated to small bulk and all coagulated proteins be removed.

Microscopic Examination of Sediment.—For blood, epithelial cells, cancer cells, Foulis' cells (these are met with in fluids from malignant ovarian cysts or malignant peritonitis following such cysts), hooklets, crystals, actinomyces nodules, amœba dysenteriae.

General Characters.—It is difficult to tell a dropsical from an inflammatory fluid. It appears that the amount of proteins in an effusion depends much more upon site than upon cause. Pleural fluids contain the highest percentage of proteins, peritoneal fluids rather less and subcutaneous fluids very little. The fluid in cardiac dropsy is more highly albuminous than in dropsy of renal origin. Diagnostically all one can say is that a fluid with Sp. Gr., more than 1.018 containing more than 4% of Albumin is almost certainly inflammatory while one with Sp. Gr., less than 1.015 and an Albumin percentage less than 2½% is certainly dropsical. Fluid obtained by lumbar puncture in cases of cerebral tumour has a Sp. Gr., 1.006 and a Protein content of ½% in chronic cases up to 1 or 2% in acute stages.—For further details see R. Hutchison and H. Rainy "Clinical Methods."

Purins.

Of the known Purin bodies, Xanthin, Hypoxanthin, Adenin, Guanin, Caffeine, Theobromine, are met with in food, and Uric Acid, Xanthin, and traces of Methylxanthin are found in urine.

(Caffeine, Theobromine, etc., are pure cerebral stimulants. They do not impair the quality of work.—Prof. Wild, L. ii./20,53.)

They all contain the grouping C_5N_4 —Xanthin is dioxypurin, Uric Acid is trioxypurin. Uric Acid is in the largest proportion of the purins—about 10 to 1 of the others.

There is, however, no special therapeutic effect in a purin-free diet.

A **purinometer** is employed for estimating. Full directions are supplied with the apparatus.

Solutions for use:—

SOLUTION No. 1.—Ammonio-Magnesium Chloride Mixture 100 Cc., Ammonia 20%, 100 Cc., Talc, in fine powder, 10 Gm.

SOLUTION No. 2.—Silver Nitrate 1 Gm., Ammonia Solution (strong) 100 Cc., Talc, in fine powder, 5 Gm., Distilled Water 100 Cc.

(Both Solutions require vigorous shaking before use.)

Ammonio-Magnesium Chloride Mixture consists of Magnesium Chloride (crystalline) 110 Gm., Ammonia Solution 250 Gm., Ammonium Chloride 110 Gm., Water 1 litre.

Guanidine Metabolism.—Its action on administration is to produce symptoms identical with those seen after removal of the parathyroid glands. Correlation needed in terms of metabolic change of *Arginine* with its Guanidine nucleus, the Guanidine bases themselves and creatine with its methylated group.—Abst. Ann. Rep. Chem. Soc., 1919 (Vol. XV.), p. 152.

Guanidine, preparation of.—E. A. Werner & J. Bell, J.C.S. Oct. 20, 1133.

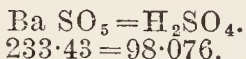
Pus.

Leucocytes in excess are recognised microscopically—especially on addition of a little acetic acid—this brings into definition the nuclei and at the same time dissolves phosphate precipitates with which a deposit of pus is liable to be confused when the microscopic examination is not conducted.

Leucocytes, Lymphocytes and Plasma cells are stained by employing Pappenheim's Stain.

Sulphuric Acid.

Total Sulphuric Acid.—Dilute 50 Cc. of specimen with equal volume of water, add 10 Cc. HCl. Heat to nearly boiling, add Barium Chloride Solution in excess. Allow to stand on water bath for an hour or two. Collect, wash and weigh.



Ethereal Sulphates. *Syn. Aromatic Sulphates.* Estimation of—SALKOWSKI'S METHOD.

The ethereal salts in urine are represented by the Potassium Salts of Phenyl-, Indoxyl- and Skatoxyl- Sulphuric Acid and similar derivatives of Catechol and Quinol.—Allen, Chemistry of Urine.

Add to 100 Cc. of specimen an equal volume of a solution composed of Saturated Barium Hydroxide Solution 2 and Saturated Barium Chloride Solution 1, allow to stand a short time and filter. Add HCl in strong excess to 100 Cc. of filtrate (representing 50 Cc. of the specimen). Heat to nearly 100° C. Collect precipitate thrown out, dry and weigh. Multiplied by 0.42 this gives the amount of Sulphuric Acid equivalent to ethereal sulphates. If subtracted from the amount of *total* Sulphuric Acid (*vide* above), the proportion of Inorganic Sulphuric Acid is obtained.

The Ethereal Sulphates normally found represent $\frac{1}{13}$ of the total sulphates. Partially derived from tissues, the greater part are due to protein decomposition in the intestine—hence their increase in disease brought about by putrefaction and obstruction—or in foul empyemata or gangrene of internal organs.—Pharmacol. See also Hewlett, P.J. i./13, 248.

In health about $\frac{1}{10}$ of the Sulphuric Acid of the urine is in the form of aromatic sulphates—aromatic poisons taken with food or formed in the intestines are made to combine with the sulphuric acid which is formed in the system by oxidation of the cystin fraction of proteins. When the intake of or formation of aromatic poisons is excessive the proportion ($\frac{1}{10}$) is higher—in *carboluria* *e.g.*, nearly all the Sulphuric Acid is so combined.—B.M.J. i./11, 1415.

Urea in Blood.

Nitrogen determination by direct Nesslerisation.—To 5 Cc. of fresh oxalated blood in a 50 Cc. flask add about 0.1 Gm. soy bean meal in the form of a 1% suspension. Allow to stand 1 hour. Then add 25 Cc. water and 2 Cc. *m*-Phosphoric Acid (25%) and make up to volume. Mix thoroughly stand 45 minutes and filter. To the filtrate add 0.5 Gm. Blood Charcoal, shake and filter. In the case of normal blood place 10 Cc. of the last filtrate (= 1 Cc. of blood) in a 25 Cc. flask. Add 5 Cc. special Nessler Solution (*antea*), make up to volume, mix and compare at once against 0.25 mgr. ammonia nitrogen Nesslerised in a 50 Cc. flask (using 10 Cc. of Nessler Solution).

If only 2 Cc. of blood are available proceed exactly as above (including coagulation in a 50 Cc. flask) except that 20 Cc. of the final filtrate (= 0.8 Cc. of blood) is taken for Nesslerisation.

Range in nine cases was from 12 to 75 mgr. Urea Nitrogen per 100 Cc. of blood.—O. Folin & W. Denis, Jl. of Biolog. Chemistry, 1916, p. 505.

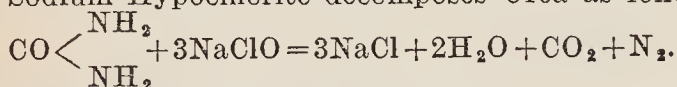
Urea in Urine, Estimation of.

Average 2.5 to 3%, or about (in health) 500 grains (33 Gm.) per diem; it may range between 15 and 40 Gm. The majority of methods are based on the decomposition of Urea into nitrogen, carbon dioxide, and water when treated with sodium hypobromite. The carbon dioxide is absorbed by the excess of alkali present, and the nitrogen

can be measured, from which, on reference to tables, the percentage can be found—theoretically 1 Cc. of nitrogen at 0° C. = 0.0027 Gm. approximately of Urea. In the process about 8% of the total nitrogen is suppressed, but the increase in volume of the gas due to the room temperature (taken as 18° C.) and the vapour tension (the gas being measured moist) has been found to almost exactly compensate for this loss in practice.

Sodium Hypobromite we found is *more accurate* than Sodium Hypochlorite, which was at one time used for the purpose—the Nitrogen being evolved more rapidly and completely.

Sodium Hypochlorite decomposes Urea as follows—



Sodium Hypobromite Solution.

Caustic Soda 100 Gm., Distilled Water 250 Cc. Dissolve, cool, and keep iced while adding *guttatim* Bromine 25 Cc.

Mix and dissolve. This solution is used to estimate the amount of urea in a given quantity of urine. On adding the solution, nitrogen is evolved from the urea and is measured in a **Doremus Tube**, in which each graduation represents 1 per cent. of urea in the urine.

It is better to keep the bromine separate; it may be sealed in tubes containing 1, 2, 3, and 4 Cc. respectively; 1 Cc. of bromine should be added to 11 Cc. of the solution as required. In place of these, **Liquor Bromi**—Bromine 1 Cc., Potassium Bromide 1.5 Gm., Distilled Water *q.s.* to 11 Cc. (= 1 in 11) may be used in equal quantity to the soda solution.

Patients treated with Urotropine pass urine which gives an orange precipitate with Bromine water. If due to Albumin, however, does not dissolve on warming.

The **Doremus** form of Ureometer is graduated on the one side in decimal parts of a Gm., of Urea obtained from the 1 Cc. of Urine operated upon, and on the other, the figures 5, 10, 15, and intermediate ones indicate grains of Urea per fluid ounce.

With the **Victoria Ureometer** (an improvement on the old Doremus form) no pipette is required, as the urine is added through a tap at the side.

In the **Urea Apparatus** arranged by the author the Nitrogen evolved displaces an equivalent volume of water and the content of Urea is easily read off from the table.

Importance of estimating urea in disease. In renal disease maintenance of normal relation between intake and output of nitrogen is essential. This is far more important than testing for albumin. The gouty patient should have the urea estimated continuously to indicate progress of metabolism. The ordinary person lying in bed will on an average, unless there be some special interference with metabolism, pass urine containing a solution of urea of strength not less than 1.4%.—See also Nephritis, Differentiation, p. 368.

If there is less urea to excrete the quantity of urine is lessened, not the strength of the solution.

See also Nitrogen, p. 407.

UREASE method of estimating Urea. Mix 25 Cc. of the urine with a pinch of powdered Soy Bean Flour (2 to 3 Gm.). Allow to stand overnight covered with a small layer of Xylol or Benzol. Render the liquid alkaline with strong Sodium Carbonate solution and distil into Standard Hydrochloric or Sulphuric Acid by Kjeldahl's procedure.

It must be remembered that the urease only attacks *urea*, 1 molecule of urea producing 1 molecule of Ammonium Carbonate $(\text{NH}_4)_2\text{CO}_3$, and that there may be present a small amount of Ammonium Salts in addition to free Ammonia. For accurate work these must be estimated separately. *c.f.* J. S. White and I. G. Williams, P.J. i./16,323.

UREASE. Experiments on with various temperatures.—J.C.S.A. i/20,103.
Urea Nitrogen determination by direct Nesslerisation:

UREASE is used as above for hydrolysis of the Urea, either in form of the enzyme or as soy bean meal. It decomposes urea quantitatively and does not affect other constituents of Urine.

Place 1 Cc. of the Urine in a 100 Cc. graduated flask. Add 0.1 to 0.25 soy bean meal in the form of a 1% suspension. Allow to stand for 1 hour at room temperature or 15 minutes at about 50°C . Add 25 Cc. of water and 1 Cc. *m*-Phosphoric Acid Solution (25%) and mix, then add 1 Gm. pure Blood Charcoal, shake, make up to volume, mix, and filter.

(The soy bean meal suspension is made thus:

Rub 5 Gm. with water 15 Cc. to a smooth paste. Add more water *q.s.* to about 400 Cc. Add 100 Cc. alcohol. 10 to 15 Cc. of this are used. It keeps good about 2 days.)

Place 5 to 20 Cc. of the filtrate in a 100 Cc. graduated flask. (The amount taken should contain 0.7 to 1.3 mgr. ammonia nitrogen.) Dilute to 60 or 70 Cc. Nesslerise with the modified Nessler Reagent, *v. p.* 408, and compare with standard (1 mgr. of Ammonia Nesslerised in another 100 Cc. flask).

Range in specimens examined 3.4 to 10.16 Gm. Urea Nitrogen per litre.—O. Folin & W. Denis, *Jl. Biolog. Chemistry*, 1916, p. 501 *et seq.*

$$\begin{array}{c} \text{NH.CO} \\ \text{Alloxan.} \text{---CO} < \text{---CO} > \text{Mesoxalylurea, is an oxidation product} \\ \text{NH.CO} \end{array}$$

of Urea. It can be made by introducing Urea in small portions at a time into strong Nitric Acid.

Uric Acid, *Syn.* Lithic Acid, in Urine, Estimation of.

$\text{C}_5\text{H}_4\text{N}_4\text{O}_3 = 168.107$. **Manufacture.**—Mix Guano 28 lbs. with 3 gallons of water. Acidulate with commercial Hydrochloric Acid. Boil, filter, and wash to remove calcium and ammonium salts (Phosphates and Oxalates). Boil the residue with Sodium Hydrate *q.s.* in 5 gallons of water—filter. Wash residue well and acidify filtrate with Hydrochloric Acid. Uric Acid separates and is filtered off. Redissolve in Sodium Hydrate, precipitate again with acid, wash and dry.

When pure Uric Acid is in white crystals, very slightly soluble in water, insoluble in alcohol and ether.

Heated to dryness on a water bath, with a little Nitric Acid or Potassium Chlorate and Hydrochloric Acid in a white dish, cooled, and a little Ammonia solution added gives a red colour.—The **Murexide Reaction**.

Luff was of the opinion that Uric Acid possesses no toxic properties whatever.

(Mean Content 0.05 to 0.06%) **Hopkins' Method.** To 100 Cc. of sample add about 30 Gm. Ammonium Chloride in powder, dissolve as completely as possible, or a small quantity may remain undissolved, add a little ammonia to neutralise and allow to stand 10 minutes. Filter off the precipitated Acid Ammonium Urate, wash with Saturated Ammonium Sulphate solution* and rinse off the precipitate from the filter with water to 100 Cc. Add 20 Cc. Concentrated Sulphuric Acid to raise temperature of the liquid to about 60°C ., or, if necessary, warm to that temp. Titrate with $\text{N}/20$ Potassium Permanganate (158 Gm. in 1 litre), taking as end-reaction the point at which the Permanganate ceases to be instantly decolourised. Each Cc. of the Permanganate Solution = 0.00375 Gm. Uric Acid.

The **Gowland-Hopkins' method** is as above to*, then proceed as follows:—Wash off the precipitate into a small beaker with a jet of hot water, add a little hydrochloric acid, and heat to just boiling. Allow to stand two hours in the cold. Collect the separated Uric Acid measuring the filtrate at the same time, for which an allowance of 1 mg. must be added on to the final result for every 15 Cc.; it need not exceed 20 to 30 Cc. Wash the uric acid

crystals with a little distilled water, rinse off the filter with hot water, warm with sodium carbonate till dissolved and make up with water to 100 Cc. Add 20 Cc. Sulphuric Acid and titrate with Permanganate as above adding slowly towards the end of the reaction, the finish being the first appearance of a pink colour which is permanent for an appreciable interval. Previously the disappearance of the colour is instantaneous.

Phospho-Tungstic Acid Test (H_3PO_4 12W O_3 +Aq) for Uric Acid. A rapid approximation.

Mix about 10 Cc. of urine with 3 Cc. of Liquor Potassæ, add 20 drops of Solution of Phospho-Tungstic Acid (20% Solution). Uric Acid causes a blue colour which varies in depth with proportion present. The method is not applicable for anything approaching an accurate colorimetric estimation as the colour fades rapidly. Use a standard for comparison of 1 in 50,000 Uric Acid.

The test can also be conducted by heating the urine with Liq. Potassæ and a 5% solution of Phospho-Tungstic Acid which gives a lilac colour. The intensity can be compared with that given by a Standard Solution of Uric Acid 1—1,000.

No relation could be found between amount of Uric Acid and health of rheumatic patients.—J. Heinemann, B.M.J. ii./13,860.

Folin and Schaffer's Modified Hopkins' method is said to give satisfactory results.—Z. Phys. Chem., 1901,32,552.—P.J. i./14,60.

Uric Acid in Blood.—Method of estimation by means of the **Hellige Colorimeter**.—See 'Blood and Urine Chemistry.'—Gradwohl & Blaivas, 1920.

Acidity of Urine.

The **Acidity of Urine**, due mostly to the Sodium Acid Phosphate, is determined by titration with Decinormal Alkali using Phenolphthalein as indicator. Each Cc. of this standard solution = 0.012 Gm. of Sodium Acid Phosphate. Acidity is frequently reported in terms of the number of Cc. of this Alkali per 10 Cc. of Urine, *e.g.*, 3 Cc. = 3°. The **Alkalinity** may be given in similar manner.

The urine of half-a-dozen individuals in health was found by us to have the following 'degrees' of acidity—0.8°, 0.9°, 0.9°, 4.4°, 5.5°, 7.2°.

It was noticeable that this gradation did not correspond with the acidity as shown by delicate litmus paper—on the contrary, the two with 0.9° were distinctly different.

Acidity of Urine. There are at least two acidities, one reacting to Methyl Orange, the other to Phenolphthalein. The acidity responding to Methyl Orange is not constant like the other.—E. & E. Pittarelli, per Y.B.P. 1919, 54.

The acidity of the urine, according to Joulie, is dependent on the 'acidity' of the blood (due to acid phosphates). *C.f.*, p. 411.

Sodium Bi-urate. $\text{C}_5\text{H}_3\text{NaN}_4\text{O}_3$ = 190.089. May be prepared by neutralising Uric Acid with Sodium Carbonate. Various opinions have from time to time been expressed as to whether the crystals are the cause or effect of the inflammation in arthritis.

A Portable **Urine Test Case** is arranged, containing the apparatus and reagents for the qualitative and approximate quantitative examination of urine for albumin, glucose and urea.

WATER ANALYSIS NOTES (CHEMICAL).

Work in an atmosphere ammonia-free. The sample of Water should be received in a 'chemically clean' Winchester quart-stoppered bottle, and dated. Note **Physical Characters**, smell, sediment, and colour in a 3 feet tube.

Total Solids are ascertained by evaporating 100 Cc. in a platinum basin on the water-bath, the result being expressed in parts per 100,000 or grains per gallon (parts per 70,000). The quantity being determined, it is essential that the amount of volatile and non-volatile matter should be determined, or, in other words, the amount of organic and inorganic solids, or those that

will disappear on ignition and those that will not. (Some of the inorganic solids, *e.g.* Magnesium Carbonate, Calcium Nitrate, will also be decomposed on ignition.) Also notice the appearance on ignition, *i.e.*, charring (indicating organic matter), fuming, scintillation, &c.

Oxygen Absorbed.—Warm $\frac{1}{2}$ litre of the sample about 20 minutes in a flask with 1 Gm. Ferrous Ammonium Sulphate $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ acidified with dilute Sulphuric Acid, then back-titrate with N/10 Potassium Permanganate.

Free and Albuminoid Ammonia.—Prepare some water, NH_3 free, by acidulating some good tap water with Sulphuric Acid, about 2 drops of a 1 in 3 solution to a litre of water and distilling. By so doing (the retort and condenser being chemically clean) even the first drop of distillate is Ammonia-free. Distillation may proceed, but must not be pushed too far. The distillate should be Nesslerised to verify its purity. Distil 500 Cc. of sample in a boiling flask with rubber cork to connect with condenser. Nesslerise each 50 Cc. of distillate with standard NH_4Cl of which 1 Cc. = 0.01 mg. NH_3 . Add together the equivalent quantities of NH_3 and double the result to arrive at number of mgrs. of **Free Ammonia** per litre = parts per million. Stop distilling and add 50 Cc. of a solution of 0.4 Gm. Potassium Permanganate and 10 Gm. Potassium Hydrate which has been freshly boiled 20 minutes. Distil again and Nesslerise the **Albuminoid Ammonia** in 50 Cc. of the distillate at a time until it is NH_3 free. Add the equivalents together and double as above for parts per million.

Wanklyn divides waters in the following:—

Class I. Of extraordinary purity, yielding from 0.00 to 0.05 part per million of Albuminoid Ammonia, which cannot be objected to organically.

Class II. The general drinking waters of this country, containing 0.05 to 0.10 part Albuminoid Ammonia per million—this amount may be considered safe organically.

Class III. Dirty waters, yielding more than 0.10 part of Albuminoid Ammonia per million.

(P) Nessler's Reagent for Ammonia. *Syn.* SOLUTION OF POTASSIO MERCURIC IODIDE.

Dissolve Potassium Iodide 7 and Mercuric Chloride $2\frac{1}{2}$, in Distilled Water 160. To this add more of the Mercuric Chloride in solution until the precipitate no longer disappears on well stirring, and a slight permanent precipitate remains. Then add Sodium Hydroxide 24, dissolve, add a little more solution of Mercuric Chloride and Distilled Water *q.s.* to 200.

On the addition of this test to ammonia or an ammonium salt in solution, it lets fall a brown precipitate which may be Di-mercuric Ammonium Iodide the equation being



Schmidt gives the composition of the body precipitated as $\text{HgINH}_2 + \text{HgO}$ —a basic Mercury-Ammonium Iodide.

For a Modified Nessler Reagent used in estimating Nitrogen in Urine and Blood, see. p. 408.

Estimation of Ammonia in Water in presence of Hydrogen Sulphide.

The presence of Hydrogen Sulphide in a water interferes with the Nessler test. If the amount of Ammonia be large the Sulphide may be precipitated with a Zinc or Lead Salt and the Ammonia can then be estimated directly by the Nessler Reagent. If the amount is small it is best to add to 500 Cc. the water, a measured quantity of N of Sulphuric Acid and distil 100 Cc.,—this completely removes H_2S . A volume of N/1 NaOH equal to that of the H_2SO_4 used is now added. The water is again distilled until 200 Cc. have collected and the Nessler test is applied to the distillate.—J.C.S.A. ii./10, 998

Chlorine. Titrate 100 Cc. in a white basin with standard AgNO_3 of which 1 Cc. = 1 mgr. of Chlorine, using potassium chromate as indicator. The reagents must be Cl-free and the water must not have an acid reaction. The average content is about 2 parts per 100,000, though frequently one finds a content of 5 to 15 parts per 100,000. It should be remembered that urine and sewage are, comparatively speaking, highly charged with chlorine—this enables the analyst to determine whether a high albuminoid Ammonia content is attributable to sewage or vegetable influence. *Per contra* almost entire absence of chlorides, coupled with excess of Albuminoid Ammonia, and little free Ammonia suggests vegetable contamination of a dangerous

character. One frequently obtains waters for examination with an exceedingly high Cl-content in conjunction with an almost total absence of organic impurity. Such waters, though 'saline,' are suitable for drinking purposes.

Nitrites. To 100 Cc. of the sample add a weak, slightly acidulated, colourless solution of Meta-phenylenediamine. Nitrites give an amber to mahogany colour according to the amount. Conduct a control experiment.

[**Metaphenylene-diamine Hydrochloride.** *Syn. Lentine* $C_6H_4(NH_2)_2.HCl$. *Dose.*— $\frac{1}{2}$ grain once or several times daily. In acute diarrhœa. Adult dose $1\frac{1}{2}$ grain to 3 grains thrice daily. The urine becomes dark colored.—Gehe, see also Brickdale.]

Nitrates. The test employed is to mix 1 part of saturated solution of a Brucine Salt with 3 parts of the specimen, and to "layer" beneath this carefully 1 part of pure Sulphuric Solution—a pink colouration indicates their presence.

Diphenylamine $(C_6H_5)_2NH=169.158$ in 1% solution in sulphuric acid is a very delicate test for nitric acid, giving a blue ring on properly layering.

In the basic condition it is practically insoluble in water and soluble about 1 in 8 of alcohol, 90%.

Diphenylamine Reagent 'A.R.' Dissolve Diphenylamine 0.085 Gm. in 190 Cc. of dilute Sulphuric Acid (1 : 3) and when cold make up to 500 Cc. with strong sulphuric acid.

Nitrates. Nitric Acid Estimation.—Treat 100 Gm. of water with two drops of a saturated solution of sodium carbonate, and evaporate to dryness on the water-bath. Treat the residue with 2 Cc. of phenol-sulphonic acid (made by mixing 148 Cc. of pure sulphuric acid, 12 Cc. of water, and 24 Gm. of phenol), add about 25 Cc. of distilled water, and then an excess of ammonium hydroxide. Transfer to a 100 Cc. Nessler jar, make up to 100 Cc. with distilled water, and compare the depth of the yellow colour with that produced by treating different amounts of standard potassium nitrate (containing 0.01 mgrm. of nitrogen as nitrate in each Cc.) in the same manner. If more than 6 parts per million of chlorine are present add to the standards before evaporation an amount of chlorine (in the form of sodium chloride) equivalent to the amount of chlorides present in the sample under examination.

Phenolsulphonic Acid, Preparation of.

Heat the Sulphuric Acid and Phenol together for eight hours (compare J.C.S.A., 1890, ii., 832) to obtain a reagent which will yield a correct red colour with Nitrates without green.—A. E. Johnson (Chem. News, 1911, 104, 233), J.C.S.A. ii./12, 89. Carbonates, *e.g.*, Calcium Carbonate, interfere with the colouration.—Chem. News, Sept. 29/11, p. 160.

Sulphates. The estimation of these is relatively seldom required. A volume of the water may be concentrated and precipitated with Barium Chloride in HCl. solution in the usual way. A new method employing Benzidine is given.—P.J. ii./15, 139.

Total Hardness.—To 100 Cc. of specimen add the least amount of soap solution (standardised so that 1 Cc.=1 mgrm. Calcium Carbonate or its equivalent) that will give a lather which will have an unbroken surface at the end of 5 minutes. 1 Cc. of the soap solution must be deducted from the amount required, as 100 Cc. of Distilled Water would require 1 Cc. to furnish a lather. The number of Cc. of soap solution required gives the number of mgrm. of Calcium Carbonate in the 100 Cc. of the specimen or the parts per 100,000.

Standard Soap Solution for the above determination:—Dissolve 10 Gm. of Hard Soap in 1 litre Alcohol 35%. 1 Cc. of this solution will contain soap approximately equivalent to 1 mgr. $CaCO_3$. To standardise to this equivalent dissolve 1 Gm. Powdered Marble or Calcium Carbonate in slight excess of Hydrochloric Acid, evaporate to dryness and redissolve in distilled Water, *q.s.*, to 1 litre. Take, say, 12 Cc. of this solution, add Water to 100 Cc., and then Soap Solution, *q.s.*, to form lather as above. Adjust the Soap Solution until 13 Cc. are required. (100 Cc. of distilled water alone would consume approximately 1 Cc. of the Soap Solution in forming a lather.) We find London tap water varies between 15° and 17° .

Poisonous Metals.—Concentrate the water 5 times after acidulating with two drops of Hydrochloric Acid. Add Ammonium Sulphydrate solution. A darkening indicates Pb, Cu, or Fe, but not Zn. This darkened water should be divided into two parts. To one add Hydrochloric Acid—if darkness goes

Fe is present. To the other portion add Potassium Cyanide Solution. If darkness goes now the metal is Cu; if it does not, it must be Pb. This latter proceeding is, of course, only necessary when the darkness does not go with Hydrochloric Acid. Confirmatory tests should always be employed. The confirmatory test for Fe and Cu is, to some original concentrated water in a test tube add Hydrochloric Acid and Potassium Ferrocyanide; a blue results with Fe, and a bronze with Cu. For Pb the Potassium Chromate test is employed. Zn gives a white precipitate with Ammonium Sulphydrate, and a white precipitate with Hydrochloric Acid and Potassium Ferrocyanide. See also Details for *Army purposes, infra*.

A pure soft water may act upon zinc, *e.g.*, on galvanised kettles, in a solvent way, so as to become dangerous to health.

Electrolysis of lead water pipes, owing to leak of 1.8 volts in earthed returns of electric cable, has resulted in contamination of the water.

ZINC in small quantities is found in soft waters passing through galvanised iron pipes. From the health aspect and danger of poisoning from, it can be ignored.—J. C. Thresh, L. ii./15,1098. See also B.M.J. i./15,80 (Park Prewett).

EXCESSIVELY PURE WATER may be solvent of lead in service water. It is recommended to harden it by adding lime.

PEATY WATERS owing to *acidity* often dissolve lead from main pipes in the form of lead hydrogen carbonate. On standing or on boiling, it is thrown out with the calcium carbonate.

LEAD-ABSORPTION from drinking water, 120 cases.—L. ii./14,213.

CHALKY WATER.—Public (and often other) opinion is to the effect that chalky drinking waters may be responsible for a variety of complaints *e.g.* gout, rheumatism, calculus, constipation, biliousness, dyspepsia, eczema, goitre and arteriosclerosis.—P.G. Lewis has stated: "There is no evidence that hard water has any bad effect—on the contrary, the evidence is all the other way."

HARD *v.* SOFT WATER.—Tabulated results of examinations give no indication whatever that the hardness or softness of waters have anything to do with the prevalence or mortality from cancer, phthisis or enteric, similarly the character of water supplies in this country has nothing to do with the general death rate.—J. C. Thresh, B.M.J. ii./13,1058.

MAGNESIUM, Estimation of. Render the water neutral to Methyl Orange and treat with Potassium Oxalate in slight excess of the amount equivalent to the Calcium present, and then with a measured excess of a mixture of standard alkali hydroxide and carbonate solutions. The liquid is then made up to definite volume and filtered, an aliquot part of the filtrate treated with an amount of Calcium Chloride equivalent to the excess of Potassium Oxalate used, and the excess of alkali titrated.—Abst. Ann. Rep. Chem. Soc. 1919 (Vol. XV.), p. 141.

Interpretation of Results.

Before a final judgment can be delivered upon any water there have to be taken into consideration (1) its geological history, (2) the rainfall before and after collection, (3) the method of storage and distribution, (4) the surface drainage, and (5) a bacterial analysis. A water which chemically is organically pure may be bacterially contaminated, and on the other hand a bacterially pure water may be chemically dangerous or suspicious.—Purvis, P.J. ii./10,149.

POISONED WATER.

A set of Tests for examination of Wells for Troops on the March, including examination for Cyanides, Alkaloids, *e.g.* Strychnine (using Bismuth - Potassium - Iodide and Phosphomolybdic Acid), Arsenic (using Zinc, HCl and Mercuric Chloride spot on filter paper), Mercury (using Copper Foil and HCl), Copper Salts (using Hæmatoxylin Solution which turns a deep blue with Copper and Iron Salts). Eliminate the latter by adding a few drops of HCl and then a few drops of freshly made Potassium Ferrocyanide Solution.

If the pp. be maroon coloured no iron but much copper is present. If both copper and iron be present, the maroon pp. of copper will be obscured. In this case insert the polished blade of a pocket knife in the water with a few drops of HCl.—and note deposit. The water if necessary may be concentrated.—John Parry, Kimberley, C.D. Oct. 23/15, 554.

The **Army Sanitary Committee** give the following scheme for detecting Poisons:—

(1) **Biological Test.**—If possible note effect on Fish.

(2) **Chemical Tests.**—Add Sodium Sulphide solution, *q.s.* *Brown* colour indicates probable presence of a metal (but the absence of a colour does not indicate absence of Arsenic).

Add Hydrochloric Acid, *q.s.*

(a) If the colour remains black or brown, **Lead, Copper or Mercury** is present.

(b) If canary yellow colour forms **Arsenic** is present. (Ignore slight milkiness of Sulphur).

Confirm by conducting a 'Marsh' with a small test-tube and glass jet, allowing the lit hydrogen flame to impinge on a porcelain plate. Black stain insoluble in dilute Hydrochloric Acid indicates Arsenic or Antimony.

For **Cyanide**. Add Caustic Soda solution and a few drops of Ferrous Sulphate solution. Boil thoroughly. Add Hydrochloric Acid, *q.s.* Blue colour indicates Cyanide especially on standing 30 minutes.

STERILISATION FOR ARMY USE.

Horrocks's Water Testing Method is used to determine the amount of Bleaching Powder required to sterilise an army water-cart full.

The method uses Zinc Iodide or Potassium Iodide and Starch Solution as reagent.—Compare Field Sanitation by Moor & Cooper (Bailliere, Tindall & Cox), also P.J. i./18,86.

The test automatically adjusts the strength of the purifier to be used, to the particular water to be treated. The Horrocks's Test Case contains 6 white enamelled tumblers (170 Cc.) and 1 black one (250 Cc.). Bleaching Powder—a levelled scoopful of about 2 grams—is rubbed fine and dissolved in the black tumbler filled to the inside mark. The white tumblers are filled with the water to be tested. One drop (1/15 Cc.) of Bleaching Powder solution is added to No. 1, two drops to No. 2, up to 6 drops in No. 6. These are stirred and left for twenty minutes, when about 6 drops of a stock solution of Potassium Iodide and Starch, are added to each. A blue colour will indicate that after all organic matter has been destroyed, an excess of available Chlorine remains, whereby Iodine is liberated with the formation of the blue Iodide of Starch. The number of the first mug of the series which shows a definite colour, gives the number of scoops of the Bleaching Powder required to sterilise the contents of one water-cart (110 gallons approx.). The powder should be dissolved before adding it to the water-cart, and contact for one hour should be allowed, before the water is issued to the troops.—'The Script,' January, 1916.

Alum Box in the Army water filtering cart contains a mixture of Alum 75% and dry Sodium Carbonate 25%. By the action of the water Alum Hydroxide is formed and deposited on the filter cloth, the jelly-like mass formed imitating the natural zoogloea layer of a sand filter bed.

Water Sterilisation with Chlorine.

Nesfield found 0.125 Gm. Chlorine per litre (125 per million) in water teeming with *B. Typhosus*, *B. Coli*, etc., sufficient to sterilise it in 5 minutes. Description of principle of **Nesfield's Sterilising Tablets**.—L. ii./o8,1708. One of Chlorine in 1,000,000 of Water acting 15 minutes will kill cholera vibrios in it.—L. ii./10,1213. *c.f. also Calc Chlorinata*, Vol. I., p. 50.

Sterilisation by means of Chlorine in proportion of 1 in 500,000 with 30 minutes contact. The gas is made by acting on Potassium Chlorate with Conc. HCl.—both of which have the advantage of keeping indefinitely in any climate.—J. J. Harper Nelson, B.M.J. i./15,789,815.

WATER.

Bacteriological Examination.

AQUA DESTILLATA.

A few years ago the opinion was expressed that saline fever occurring after infection of Salvarsan was due to the "dead" bacteria in the saline solution used as solvent of the arsenical compound.

Donald's Method of counting Bacteria in water includes the dead bacteria, whilst the usual cultural methods eliminate them. Extraordinary differences are recorded. A water, for example, grown on Agar two days at 37° C. showed no organisms. On gelatin at 18 to 22° C. 10 to 14 days showed 160—300,000 per Cc., whilst by Donald's method there were 1,500,000 per Cc.

For conducting the method special capillary pipettes made with Bunsen flame are required. These are gauged by means of a standard wire gauge. Drops of the water from pipettes of one calibre are equal in size in certain circumstances. Bacteria contained in the water are counted by evaporating and staining on micro-slides. By the method it was shown that Distilled Water kept for three weeks may develop as many as 15,000,000 of bacteria per Cc.—L. i./13,1447.

Sixteen specimens from various drug stores (*abroad*) were examined, and only two found to contain less than 100,000 germs per Cc.—two having over 700,000 and one 6,050,000. P.G. requires that 100 Cc. on evaporation shall leave not more than 0.001 Gm., i.e., 1 in 100,000 of unknown substances. Suggestion that water should be examined biologically by testing on *Spirogyra*—to test for metallic impurities.—P.J. ii./13,808.

Experiments with Distilled Water.

It seemed of importance to determine to what extent bacteria may *increase* in Distilled Water on standing.

500 Cc. of fresh Distilled Water were exposed in a flask and counts made in the usual manner periodically. Examination at the commencement showed *the water to be sterile*.

After 3 days there were 111 organisms per Cc. capable of growth on gelatin [at 18° C

„ 10	„	„	52,000	„	„	„	„	„
„ 15	„	„	3,800,000	„	„	„	„	„

At this time there was only one organism per 2 Cc. capable of growth on Nutrient Agar at 37° C.

These results show the remarkable contamination in Distilled Water which may occur by air organisms. Whilst demonstrating the importance of fresh Distilled Water, the relative absence of pathogenic organisms is also of great interest. The cultural method is clearly satisfactory as far as it goes. We have had no personal experience with Donald's method of counting.

Ordinary Chemical means failed to detect any difference in the Water either at the commencement or end of these experiments.

Hort and Penfold state that on adding 1 or 2 Cc. of Distilled Water direct from the condenser drips of a laboratory distilling vessel to Agar tubes will show a large proportion of infected tubes on incubation.—L. i./13,482.

We conducted some experiments on this matter. Five Agar plates were cultivated at about 30° C. with 1 Cc. of Distilled Water collected direct from the worm of a laboratory still. Two of the plates showed

about 1,000 colonies each, mostly *Staphylococcus Aureus*, two were covered with *B. Subtilis*. A control plate showed one colony only. Sloped tubes of Agar covered with 1 Cc. of the water in each did not show any apparent growth. The result indicates contamination of the water in the condensing tube from the surrounding air. The water itself, initially, would be sterile.

Drinking Distilled Water, it is said, may be injurious to the system—by osmosis. To drink hard water cannot bring on old age (a fallacy commonly credited).—L. i./13,1813. We doubt this. The same could be said of ordinary water as the difference in osmotic pressure between distilled or ordinary tap water is inappreciable.

Distilled Water as a Therapeutic Agent.—Distilled Water injected in dose of 6 to 8 Cc., syphilitic ulcers well treated by—they assumed a healthy appearance after three injections. The theory is that increased surface tension has a good deal to do with beneficial results of injections.—G. Arbour Stephens, L. i./13,799.

C. F. Marshall thinks the effect of Salvarsan may be due, in part at least, to the amount of water injected. Hypodermic injections of ordinary clean water have a therapeutic value by stimulating all the histological structures of the body into renewed activity, causing leucocytosis and increasing phagocytosis.—B.M.J. i./13,794; Pres., May, 1913,172.

DRINKING WATERS.

Bacteriological Examination.

Collection of Sample.—The apparatus used for collecting the sample is that of V. Esmarch, or a simple modification of it. Briefly it consists of a sterile bottle which can be opened below the surface of the water,—at any depth by aid of a suspending string. A bottle of capacity 500 Cc. can be used.

If from a water-supply, the water should be allowed to run at least half an hour before collecting; if from a reservoir or stream, surface water must be avoided by holding the bottle at least one foot below the surface.

For comparative purposes it is important to know whether the water, *e.g.*, a well, has been recently disturbed by cleaning out or pumping. Also to examine as quickly as possible after collection of the specimen, particularly in hot weather. To prevent increase in number of bacteria it is customary to pack the bottle in ice for transmission by rail, &c.

Unless the water be packed in ice there is a chance that saprophytic organisms may multiply at the expense of organisms indicative of pollution.

Enumeration of Bacteria.—Agar and gelatin plates are prepared with varying quantities of the specimen, *e.g.*, 1·0, 0·1, 0·01 and 0·001 Cc. and incubated at their respective customary temperatures and the colonies counted. A very pure water might of necessity require 3 Cc. The easiest way to do this is to draw sector lines with a paraffin pencil through the petri dish, count one section, and multiply out to obtain the number of bacteria in the entire amount of water taken for examination. **Pakes' Discs** are employed in a similar manner. To obtain accurate results it is important to add the melted gelatin or agar medium to the specimen of water, and not the water to the medium. This procedure ensures better mixing.

The plates are examined daily, and if liquefying organisms are numerous (which suggest sewage pollution) the examination has often to be concluded in a shorter time than would be necessary where such are not present: if possible a week should be devoted to growth.

By cultivation on Gelatin at 20° C., we enumerate the bacteria present normally in the water, whilst the body temperature 37° C. will be more suitable for excremental organisms—derived from, or pathogenic to, the animal body.

As glucose media are very favourable to the growth of many of the yeast and fungi it is advisable also to prepare a plate culture using this medium.

Yeast and fungi are therefore often not included in the count with the ordinary media owing to the non-favourable condition for their development. We have proved this with ordinary laboratory tap-water.

J. C. Thresh ('Examination of Waters,') says it is desirable to avoid stating that water contains a certain *number of organisms per Cc.*, since such a determination is practically impossible. It is better to state the number of colonies which *grow on a certain medium under specified conditions* of time and temperature and to add whether the colonies were visible to the naked eye or under a certain magnification. He uses nutrient gelatin having a ± 1 (acid) reaction.

The next step is to conduct individual search for various sewage polluting organisms, *e.g.*, *B. coli communis*, *B. typhi abdominalis*,—especially the *B. coli* group, *Vibrio cholerae*, *B. proteus*, Klein's *B. enteritidis sporogenes*, and *Streptococci*.

B. Coli Communis—MacConkey's Medium.

The entire problem turns on determining whether pollution with sewage has occurred. For this purpose the detection of the *B. Coli* group of organisms is virtually *the* factor. If we obtain acid and gas production in McConkey's Litmus Bile Salt Glucose Broth Medium we have presumptive evidence of the presence of *B. Coli*, *B. Paratyphosus*, *B. Enteritidis*—but excluding *B. Typhosus* and the dysentery organisms. These latter produce acid formation only (without gas) in this medium.

Fill ordinary test tubes into which Durham's tubes are introduced, with the following special broth (bile salt broth)—Sodium Taurocholate 0.5, Glucose 0.5, Peptone 2 Gm., Water 100 Cc., with 10 Cc. of 18% Sterile Litmus Solution.

Another step is to employ the McConkey Medium made with **lactose** instead of glucose—this forms a useful corroboration for *B. Coli*—this organism gives acid and gas whereas none of the others do so. In tabular form the matter may be stated as follows:—

	GLU- COSE.	LAC- TOSE.	MOTIL- ITY.	GELA- TIN.	LIT- MUS MILK. 3 DAYS.	IN- DOL.
<i>B. Coli Communis</i> ..	A.G.	A.G.	+	—	A.C.	+
<i>B. Typhosus</i> ..	A.	—	+	—	A.	—
<i>B. Paratyphosus</i> ..	A.G.	—	+	—	Alk.*	—
<i>B. Enteritidis</i> (Gaertner) ..	A.G.	—	+	—	Alk.	—
<i>B. Dysent. (Shiga)</i> ..	A.	—	—	—	Alk.	—
<i>B. Dysent. (Flexner)</i> .	A.	—	—	—	Alk.	+
<i>B. Morgans No. 1</i> ..	A.G.	—	+	—	O	+

A = Acid. G. = Gas. C. = Clot. — under Gelatin means non-liquefaction. * *Vide* also Eyre Bact. Technique, for *B. Paratyphosus*, *A. and B.*

The other distinguishing factors in the table are of importance in determining specificity.

The data in question, together with the production of fluorescence in the colonies in **Rebipel Agar**. *Syn.* **McConkey's Neutral Red Bile Salt Agar**—which has the composition:—

Agar and Peptone White	..	..	..	..	..	aa. 30 Gm.
Lactose	..	..	..	..	..	15 Gm.
Sodium Taurocholate	..	..	..	..	..	7½ Gm.
Tap Water	..	..	..	..	..	1500 Cc
Solution of Neutral Red, 1%	..	..	..	..	..	7½ Cc.

constitute the '**Flaginac**' Reaction which is typical of *B. coli*.

This word is made up to show the reactions on these media and is applied to organisms, *e.g.*, *B. Coli*, which will respond to all:—

fl : fluorescence in neutral red.

ag : acid and gas formation.

in : indol in peptone water.

ac : acid and clot in Litmus milk.

Neutral Red $C_{15}H_{16}N_4$ (*Syn.* Toluylene Red) is chemically Dimethyl-diamido-tolu-phenazine hydrochloride. It is readily soluble in alcohol and in ether.

The exact mode of procedure which we employ for the detection of Acid and Gas formation is as follows:—

First for Examination of 100 Cc. of the Water we place 50 Cc. of **Triple Strength of McConkey's Broth Medium made with Glucose** into a 150 Cc. bottle (an ordinary strong green flint bottle is suitable), containing a small inverted test tube, rendered bubble free *secundum artem*. The whole is then plugged with Sterilised Wool and sterilised on three succeeding days in the usual manner. This has to be made ready before receipt of the specimen. 100 Cc. of the sample to be examined is introduced with aseptic precautions.

The same procedure is gone through with the *Lactose* preparation. These are then incubated 24 hours.

For the Examination of 50 Cc. of the Water we take 50 Cc. of **Double Strength** McConkey's Medium made with Glucose and Lactose respectively and 50 Cc. of the specimen in a 100 Cc. bottle, and incubate as before.

For Examining 10 Cc. of the Water we take 10 Cc. each of the Double Strength Media and 10 Cc. of the sample and proceed on exactly the same lines.

Subsequent to these results we inoculate Neutral Red Bile Salt Agar Plates with loopfuls from the cultures in the bottles—using a 'spreader' made with a piece of glass rod $\frac{1}{8}$ inch diameter with a bent end about $1\frac{1}{2}$ inches long at right angles to the handle.

After incubating 24 hours pick out with a platinum loop Colonies resembling those of *B. Coli*, and inoculate Sloped Agar tubes, *thence* Peptone Water for the Rosindol Reaction and Indol Reaction—also Litmus Milk for the 'Acid and Curd,' and examine a fresh broth culture for motility.

The plate cultures are incubated further to observe fluorescence, if any.

Rosindol Reaction (Ehrlich's). *Syn.* Böhme's Indol Test.—To 10 Cc. of a 48 hour Peptone Water culture add 5 Cc. of the following solution:—

Paradimethyl-amido-benzaldehyde	..	..	..	1
Alcohol, 96%	..	..	..	95
Concentrated Hydrochloric Acid	..	..	..	20

and then 5 Cc. of Saturated Aqueous Potassium Persulphate Solution. Shake well. McConkey says 1 Cc. of each solution is sufficient, and we have found it so. Pink colour in a few minutes = +. In some cases the Persulphate need not be added. The pink colour is soluble in Amyl Alcohol—a little of which should be added, especially in doubtful cases. At least 48 hours growth should be allowed, in some cases 6 to 8 days are required.

Indol Reaction.—To 5 Cc. of the (6 or 7 days) Peptone Water culture add 1 Cc. of Concentrated Sulphuric Acid and then 1 Cc. of 0.02% Sodium Nitrite. Pink colour indicates Indol production (some organisms, *e.g.*, cholera vibrio do not require the Sodium Nitrite—hence the test may be done in two stages). It may be necessary to incubate for 8 days or more before conducting the test.

Our own experience with these two reactions is disappointing—on the whole we think the Rosindol Reaction is the more conclusive (*c.f.* also *B. Coli* in Urine).

The formation of Indol amongst the '*flaginac*' characters of *B. Coli* is the character most liable to be absent in *B. Coli* isolated from urine (and water). The Rosindol Test preferred.—A. R. Tankard, P.J. i./13,126.

Thresh gives the following as "**decisive tests**" for *B. Coli*. (1) Acid and Curd in Litmus Milk (2 and 3), Motility and Indol in Peptone Water. (4) Negative to Gram's stain. (5) Liquefaction with streak cultures on gelatin. (6) Fluorescence on Rebi-pelagar (7, 8 and 9). Fermentation of Sucrose, Mannite and Dulcitol respectively.—(Examination of Water Supplies, 2nd Edition.)

Gaertner deals with the difficulties of examining water for this organism. A thorough investigation of the source and history of a water under examination is necessary,—this is more important than laboratory diagnosis. To ascertain the *origin* of the organism if found,—whether from sewage or other human source, cattle, cultivated lands, etc.—B.M.J. i./11,1334.

Sodium Salicylate 0.25% is said to inhibit growth of *B. Typhosus*. In *Nutrient Broth* even 0.2% will do so. Useful for demonstrating *B. Coli* in sewage polluted water. The only organism likely to grow with *B. Coli* is *B. Subtilis*, which can be separated by plating and tested by sugar fermentation.—L. ii./12,439; P.J. ii./12,270.

B. Typhosus.—In searching for this organism, which is a very difficult matter, and almost invariably attended with negative result, the enrichment method of Hoffman and Ficker is recommended side by side with some method of chemical precipitation. It is the custom to accept the indirect bacteriological evidence obtained by the *coli-form* data, as sufficient for the purpose of condemning or passing a water for drinking purposes. Scheme of work for isolating *B. Typhosus*:—

- | | | | |
|----------------------------|---|--|---------------|
| 1. ISOLATION | { | 1. Chemical precipitation—Schüder's or Ficker's process. | |
| | | 2. Serum agglutination. | |
| | | 3. Caffeine enrichment process. | |
| | | 4. Solid Media { <table border="0" style="display: inline-table; vertical-align: middle;"> <tr><td>Rebipel Agar.</td></tr> <tr><td>Glucose and Lactose Agars.</td></tr> <tr><td>Drigalski-Conradi Medium.</td></tr> </table> | Rebipel Agar. |
| Rebipel Agar. | | | |
| Glucose and Lactose Agars. | | | |
| Drigalski-Conradi Medium. | | | |
| 2. IDENTIFICATION. | { | Morphological and cultural characters, &c. | |
| | | Specific Reactions : Pfeiffer's Agglutination Test. | |

Schüder's Process consists in adding to 2 litres of the water 20 Cc. of 7.75% Solution of Sodium Hyposulphite and 20 Cc. of 10% Lead Nitrate Solution. Plates are made from the precipitate containing the bacilli.

Ficker's Process.—Render 2 litres faintly alkaline with Soda and add 7 Cc. of 10% Ferrous Sulphate Solution. The precipitate is dissolved in 25% neutral Potassium Tartrate, and plates are prepared.

Serum Agglutination.—Add 1 Cc. of the sample to each of a number of broth tubes, and incubate at 37° C. three or four days. To those with sediment add a few drops of active anti-typhoid serum. Clumps are centrifuged, and the clear liquid drawn off. Emulsify deposit and prepare plates.

Caffeine Enrichment process.—To the sample add Nutrose (a proprietary Sodium Caseinate) 1%, Caffeine 0.5%, Crystal Violet 0.001%. Incubate 12 hours at 37° C. Isolate typhoid bacilli on plates,—the colon bacilli will have been almost entirely restrained in their growth; the method is, however, not wholly reliable.

Solid Media.—**Drigalski-Conradi Medium** consists of a nutrose-lactose-litmus agar containing 1% Nutrose* 1% Peptone, 0.5% Salt, 3% Agar, 1.5% Lactose, in a nutrient broth made with 750 Gm. Horse Flesh to the litre, also 13% of Kübel and Tiemann's Litmus Solution and a trace (0.001%) of Crystal Violet. After incubation typhoid colonies are blue, glassy like dew drops, Paratyphoid similar, and *B. Coli* are bright red and opaque. See also Abel & Gordon's Handbook, and J.I. Hygiene, Oct., 1905.

Rapid method which may be utilised in search for *B. typhosus*.—“Concentrate” at least two litres of the water by filtration through a Chamberland filter. Brush off the organisms from surface of candle into sterile vessel containing about 10 Cc. of sterile water. Brush plates with the emulsion and cultivate in the ordinary manner on gelatin and agar, with the addition of phenol 0.05%. This addition inhibits many common water bacteria, but not *B. Typhosus* or *B. Coli*. After incubation suspicious colonies are picked out and cultivated on various media, concluding with the serum diagnosis method of Pfeiffer.

Vibrio Cholerae.—To detect: inoculate peptone water, preferably in an Erlenmeyer flask with 100 Cc. of the water. Incubate and test for indol production and search for typical comma-shaped organisms, which are actively motile and decolourised by Gram's method. Test further with usual laboratory media, and also conduct serum agglutination test.

* Nutrose T.M. 215,950 renewed 1913, Patent 22,190/1894, became void in the seventh year.

The above method somewhat modified used for cultivation. For identification are motility, Cholera Red Reaction, Nitroso Indol, Ehrlich's Rosindol Reaction, Flagella staining, and Agglutination Test. Possibilities of carriers.—L. i./13, 1377.

B. Proteus.—The ordinary laboratory media and methods may be employed for the various types of *Proteus*.

Bacillus Enteritidis Sporogenes.—Eyre (Bact. Technique) states, this bacterium is relatively scarce in water and the search for it is not usually included in the routine examination. Add to a fresh milk tube 1 Cc. of the water or a small quantity of the 'concentrated' water. Heat to 80° C. for 20 minutes to kill off other organisms, excepting spores of the organism searched for (Kitasato's method): grow in Buchner's tube, i.e., in an atmosphere of nitrogen for 24 to 36 hours. If result be separation of milk, stringy curd, and excessive whey, test for pathogenicity on guinea-pig. The animal succumbs within 36 to 48 hours (if very virulent in 24). Post-mortem signs: bloody œdema at seat of inoculation, offensive odour, hair of animal easily detached. Films stained by Gram's method from œdema fluid show typical non-sporing organisms. To further test, a blood serum tube is inoculated from the œdema fluid and incubated under anærobic conditions. The medium is eventually liquefied by the organism, and films prepared from this show the typical sporing organism of Klein.

Streptococci.—Eyre (Bact. Technique), states the Streptococci are frequently termed 'microbes of indication,' as their presence is held to be evidence of pollution of water by material from the mammalian alimentary canal—thus constituting a danger signal. Glycerin Agar is a good medium for this organism. Agar plates may be brushed or prepared in the ordinary way, incubated at blood heat, and all discrete colonies examined by films or ordinary sub-cultures made on various laboratory media.

DRAWING UP BACTERIOLOGICAL REPORTS ON WATERS.

If *B. Coli* form a considerable proportion of the total number of organisms present there is great reason to suspect sewage pollution.

It must also be remembered that *B. Coli* may be of human intestinal origin or a natural inhabitant of the water. Muir and Ritchie, for example, mention a moorland water with high *B. Coli* content—certainly *not* of human origin—hence it is of importance if possible to examine the nature of the surroundings.

The following is a brief résumé of the customary standards :

A water generally speaking containing B. Coli in 50 Cc. but not in less is quite good if the count of total bacteria and chemical result are good. See also filtered London Lea River Water p. 427.

Wells, Shallow and Surface.—

If chemical results and surroundings are bad, even if *B. Coli* be absent from a large volume of the water, it should be condemned, and *per contra* if in a suspicious locality the bacteriological examination is bad the water ought to be condemned even though chemically it could be passed.—M. and R.

Wells, Ordinary or Medium Depth.—

Total Bacteria.—The Gelatin Count may show from 100 to 2,000 organisms per Cc. The presence of *B. Coli* in 10 Cc. would condemn the water.

Wells, Deep.—

Total Bacteria.—Should not exceed 100 bacteria per Cc. Artesian Wells and some springs may contain very small amounts, e.g., 5 or 10 organisms per 100 Cc.

Presence of *B. Coli* in 100 Cc. or less cannot be permitted.

Rivers.—Draw conclusions as under Wells (Shallow). Content varies enormously with season.

Total Bacteria.—The Gelatin count varies enormously. *B. Coli* in 10 Cc. would condemn.

Town Supplies (Filtered).—

Total Bacteria.—Should not show more than 100 Bacteria per Cc.—Muir and Ritchie.

For *B. Coli c.f.*, Lea River Water *infra*.

London (Lea River filtered).—

Though *B. Coli* in one series of examinations was present in 93% of samples in 1 Cc. or less before filtering it was absent from 100 Cc. in 62% of samples after filtering, and therefore present in 38% in 100 Cc.—Houston.

A well known authority on Bacteriological Examinations of Water informs us that he would expect ('exceedingly likely') *B. Coli* in 100 Cc. main tap water in London.

A further report (1912) resembles previous ones in being favourable. Dealing with *B. Coli*, taking one figure results, this organism occurs in raw Thames water to the extent of 19 organisms per Cc., Lea water 5 organisms, New River 2 organisms. For filtered waters a one figure result per Cc. of water—expressed as typical *B. Coli* per 1,000 Cc., gives Kent 1 to 2, West Middlesex 14. New River 2 to 3.—A. C. Houston, B.M.J. ii./12,1671.

Raw Thames water in 1912-1913 contained 6,550 microbes per Cc., Lea water 11,772, New River 2,777. On filtering the figures were respectively 14.5, 30.5, and 12.6—indicating a percentage reduction of 99.8, 99.7, and 99.5. Too much stress, however, must not be laid on percentage reduction. The worse a water is initially the easier it is to obtain a big percentage reduction.—A. C. Houston, B.M.J. ii./13,678. This authority has recently issued a monograph, 'Studies in Water Supply' (Macmillan), *c.f.*, L. i./14,398.

Algae in Water. POTASSIUM PERMANGANATE.—2.5 to 5 pounds per million gallons is efficacious in removing the nauseous taint due to *Algae* in reservoirs—better than Hypochlorite.—A. C. Houston, B.M.J. ii./16,817.

Houston's Tenth Research Report.—Further research for the Typhoid bacillus in crude sewage. Raw river water is purified 1,000 times before delivery to consumers. With regard to purified water, there is no possibility of cumulative microbial effect. It is stated further that more than one Typhoid bacillus is needed to infect a susceptible person with typhoid and in no conceivable circumstances can the typhoid bacillus multiply in water.—B.M.J. i./15,477.

EXCESS LIME METHOD of treating water is effective for sterilising and purifying, and when necessary Softening* water.

Liming the Dee as a means of overcoming sewage pollution.—

The Aberdeen water is soft (2° Clark's scale) hence the amount of Lime necessary is relatively smaller than would be required with the London water. Three parts per 100,000 were used. The method is very efficient in killing off *B. Coli*. Before the liming *B. Coli* was found in 1, 5, 10, 15, and 100 Cc., and on four occasions (during 8 days) not at all, whilst after the liming there was a run of 18 days in which no *B. Coli* was found in 100 Cc., and when the lime was stopped *B. Coli* appeared again.—B.M.J. ii./13,140.

* **Permutit** system of Water Softening. Permutit is an artificial zeolite a compound of silica, alumina and soda. In contact with hard water it abstracts the Calcium and Magnesium constituting the hardness in exchange for a soda complement. The lime and magnesia are left behind in the cylinder and the corresponding sodium salts pass into solution.—L. i./15,214. For further details on water softening see Vol. I., p. 690.

Miguel's Standard.—Pure water may contain 100 to 1,000 organisms per Cc., very impure being defined as containing 100,000 and upwards.

Sewage (Crude).—Total organisms in London sewage found to be 6 to 12 millions per Cc. *B. Coli* never fewer than 100,000 per Cc. —Klein and Houston.

CHEMICAL AND BACTERIOLOGICAL EXAMINATIONS OF DRINKING WATERS COMPARED.

It appeared of great importance to determine the relationship existing between chemical and bacteriological reports on Drinking Waters. It is common knowledge that a water may pass certain standards chemically and yet be unsatisfactory from the bacteriological aspect. The converse may also be true in some cases.

We instituted a research on these lines and in the table on p. 430, *et seq.*, we bring together the more important data which we obtained chemically and bacteriologically.

The Waters dealt with comprise a representative selection of Drinking Waters as supplied *from the main* to private consumers in some of the leading cities and health resorts in Great Britain. The selection includes, for example, the supplies of London, Glasgow, Bath, Blackpool, Buxton, etc., etc.

We omit the names of the cities in several cases.

Official Reports in comparison with our findings.

Medical Officers of Health in certain instances provided us with their recent Analytical reports and we append some details.

Water No. 1.—This water supply is at the time undergoing complete reorganisation. *B. Coli* had been found in 50, and in 10 Cc. and sometimes in 1 Cc. during stormy weather.

Water No. 9.—A report, stated chemically and bacteriologically of the highest quality. Organisms 10 to 14 per Cc. No *B. Coli* in 1 Cc.

Water No. 11.—A report stated: 1 to 3 organisms per Cc. on incubation at 37° C. *B. Coli* absent from 1 Cc. Water very good bacteriologically.

Water No. 13.—A report stated: No evidence of contamination —June 24th, 1914.

Water No. 14.—A report stated: Free Ammonia nil, Albuminoid Ammonia "0.0006" (presumably per 100,000), Chlorine 2.65.—December, 1913. Bacteriologically 5 to 7 organisms per Cc. capable of growth at 22° C. and *no* organisms capable of growth at 37° C. in 2 Cc. *B. Coli* absent from 60 Cc.—Examined July, 1914.

Water No. 16.—A report stated "fulfills chemically and bacteriologically every requirement that would be regarded as desirable in a model supply."

We are of opinion that marked divergence would be found, especially in the bacteriological findings between examinations at the source of supply—lake, reservoir, etc., and from the main taps in private dwellings. This factor explains in great measure the differences between our reports and the “Official” data provided by Public Health Authorities.

Conclusions.

The conclusions we may draw from our own investigations are :—

(1). The bacteriological investigation is more useful than the chemical—and should at any rate always accompany a chemical examination.

(2). The absence of *B. Coli* from 100 Cc. of a water is an ideal seldom attained.

(3). The albuminoid ammonia content is no indication of the number of bacteria.

(4). Examination of waters at the source and after traversing some miles of water supply pipes may show marked differences.

Speaking generally, we were gratified to find these town supplies of good quality.

Swimming Bath Water.—It was found that the water in question on entering the bath contained 43 organisms per Cc. Coli-form or intestinal organisms were present in 5 Cc. but not in 1 Cc. Water from the 1st class bath after 194 people had been in it gave 2,850 organisms per Cc. Coli-form organisms present in 5 Cc. The 2nd class bath after 767 persons had been in it gave about 15,000 organisms per Cc. Coli-form or intestinal organisms in 0.5 Cc. water, but not in 0.1 Cc. On another occasion twenty times the quantity of organisms were found in the 2nd class bath. Further examinations showed that the average number of organisms in two samples of 1st class was 110,000 per Cc., and the average in three samples of 2nd class was 126,000 per Cc. Though many more individuals had used the 2nd class bath the water was not so very much worse than the 1st class,—the organisms in both cases were both pathogenic and non-pathogenic. Recommendation to empty the baths more often.—L. ii./10,542,578

TABLE OF COMPARISON OF CHEMICAL AND BACTERIOLOGICAL
EXAMINATIONS OF DRINKING WATERS CONDUCTED IN OUR LABORATORIES,
SEPTEMBER TO NOVEMBER, 1913.

Source.	Chemical.					Bacteriological.										Our Conclusions.	
	Ammonia. Parts per million.		Chlorine parts per 100,000.	Solids parts per 100,000, and effect on ignition.	Bacteria per Cc.		Volume pro- ducing Acid and Gas in MacConkey Broth with		Rosindol Reaction.	Indol Reaction.	Fluorescence on Reibel- agar plates.	Acid and Clot in Litmus Milk.		Motility.			
					Gelatin at 20° C.	Agar at 37° C.	Glu- cose†	Lac- tose†				Acid	Clot				
	Free.	Alb.	1.	2.					3.	4.	5.			6.	7. Cc. 10		8. Cc. 10	9.	10.	11.	12.	13.	14.	15.
WATER No. 1	Nil.	0.06	1	6 Much charred on ignition	100	160				+	+	+	+	+	+	+	Chem., Good. Bact., Not satis- factory.
No. 2 BATH	0.02	0.034	2	36 slight charring	972	8		100	100 50 acid only.	—	—	—	+	+	+	+	Chem., Excellent. Bact., Satisfactory.
No. 3	Nil	0.06	1.5	12 slight charring	1,209	57		10	50	—	+	+	+	+	+	+	Chem., Good. Bact., Satisfactory.
No. 4 BUXTON	0.03	0.12	1	15 much charring	45	80		No acid or gas with 100 Cc.	No acid or gas with 100 Cc.	—	—	—	—	—	—	—	Chem., Safe organi- cally. Bact., Excellent.

ANALYTICAL MEMORANDA.

No. 5	0.026	0.056	5	45 very slight charring	172	199	10	10	+	+	+	+	+	Chem., Good. Bact., <i>Not</i> satis- factory.
No. 6	Nil.	0.026	3	30 not charred	1,109	37	50	50	-	-	+	-	-	Chem., Excellent. Bact., Satisfactory
No. 7	0.026	0.03	1	3 charred	at least 1,000 some liquefng.	820	10	10	-	-	-	+	+	Chem., Excellent. Bact., Might be better.
No. 8	0.08	0.12	1.5	18 charred	at least 1,000 some liquefng.	1,600	50	50	-	-	-	-	-	Chem., Safe organi- cally. Might be better.
No. 9	0.01	0.036	6.5	45 very slight charring	1,040	242	50	50	-	-	-	-	-	Chem., Excellent. Bact., Satisfactory.
No. 10 Village	0.08	0.168	10.5	70 charred	10	60	1	10	+	+	+	+	+	Chem., Unsatis- factory.
Ditto B . . .	0.026	0.12	10.5	68 charred	B. Sub- tilis pre- vented count	75	100	100	+	+	+	+	+	Chem., Bad. Unsatis- factory. Bact., Satisfactory.
No. 11	Nil.	0.11	1.5	6 Much charred	3,000	50	10	10	+	+	+	+	+	Chem., Safe organi- cally. Unsatis- factory.

No. 16	Nil.	0.03	3.2	30 not charred	at least 1,000 liquefy- ing	820	10	10	—?	+	—	+	+	+	Chem., Excellent. Bact., Unsatis- factory.
No. 17	0.02	0.015	70	210 much charred	at least 1,000 liquefy- ing	410	100	100	+	+	+	+	+	+	Chem., Unsatis- factory. Bact., Unsatis- factory.

* Pathogenic and intestinal organisms grow best at this temperature.

† Presumptive evidence of *B. Coli*, *B. Paratyphosus*, *B. Enteritidis*, but excluding *B. Typhosus* and Dysentery Organisms.

‡ Confirmatory for *B. Coli* as *B. Typhosus*, *B. Paratyphosus*, *B. Enteritidis* and Dysentery organisms do not give it.

Columns 7 to 13 include the "Flaginac" Reaction.

Columns 9, 10, and 14 show results of tests made on cultures in peptone water from the least quantity of MacConkey's Broth Culture showing acid and gas;

MINERAL WATERS.

The following information regarding mineral waters has been obtained by applying in most instances direct at the sources.

The arrangement of the paragraphs is as follows:—

The name of the water and locality is given, then follow in order the names of spring or springs, the nature of the water, the chief chemical constituents, the medicinal uses, the season, if any, at the health resort, and an indication as to whether the water is imported in the bottled condition. The accounts of some are, however, condensed. 'Sulphurous' is to convey Sulphuretted Hydrogen with (usually Sodium) Sulphates and Sulphides.

See also "Selection of Patients for Spa Treatment."—A treatise on the subject.—N. Wood.—L. ii./09, 1276, also "Heath Resorts of the British Islands," by the same author.

Mineral Waters for *Intravenous and Intramuscular injections* as Artificial sera. See Vol. I. p. 698 *et seq.*

[P] :—Poisons.—We have adhered to the letter of the law viewing mineral waters containing Arsenic as 'Medicinal Preparations of Arsenic, but obviously we are concerned here *de minimis* in some instances—in others again the amount is very considerable.

Aedipsos (GRECIAN).—Saline thermal. **Aegina** (GRECIAN).—Alkaline Imported.—Ph. Notes.

***Aesculap** (HUNGARY).—Aperient. Magnesium and Sodium Sulphates, Sodium Chloride and Calcium Sulphate. Occasional and habitual constipation, bowel and liver disorders. Imported. See also Table of Mineral Waters.

Aix-les-Bains (SAVOY).—Anti-rheumatic. Sulphur and an organic matter called Baregine, which renders it easy of digestion, oily and suitable for massage. Rheumatism, gout and throat diseases. 1st April to end of October. Also imported. Employed as tubs, shower bath, massen and vapour baths, with good results to wounded soldiers.—L. Blanc, L. ii./15, 174.

Alet (AUDE, FRANCE).—Source des Bains and Source Nouvelle.—Alkaline carbonated. Debility, dyspepsia, anæmia. Imported.

Allevard (ISERE, FRANCE).—Sulphurous carbonated Calc and Magnesium Bicarbonates, Sodium Chloride, Calcium, Sodium and Magnesium Sulphates, free Sulphuretted Hydrogen, Carbonic Acid and Nitrogen. Chest affections of all kinds, skin diseases, women's diseases, rheumatic complaints, June 1st to September 30th, and imported.

Alvaneu-Bad (near ENGADINE).—Sulphurous. Alpine Climate.

Andros (GRECIAN).—Chalybeate.—Imported.—Ph. Notes.

***Apollinaris** (NEUENAU, GERMANY).—Acidulated alkali table water. Sodium Chloride, Calcium and Magnesium Bicarbonates, with large excess of carbonic acid. Catarrhal affections of the respiratory organs and mucous membrane, acute and chronic laryngitis, bronchitis, dyspepsia, gout and gravel. Imported. See also Table of Waters.

***Aquaperia**. T.M. 363617, class 44. (HARROGATE, GT. BRITAIN).—A natural tonic aperient water, standardised and of high organic purity. Dose a wineglassful before breakfast. For constipation, liver disorders and bilious complaints. Relieves gout and rheumatism and helps to prevent indigestion.

Bagnères-de-Luchon (HAUTE GARONNE) and **Bagnères-de-Bigorre** (HAUTES, PYRENEES, FRANCE) Labassere.—Sulphurous. Skin, lung and rheumatic affections.

Bagnoles-de-L'Orn (NORMANDY, FRANCE) Grande Source.—Small quantities of Sodium Chloride, Sodium Sulphate and Silica, also traces of Potassium Iron and Calcium Salts. Used chiefly as baths and douches but is also drunk, Phlebitis, varicocele, women's diseases and rheumatism. May 15th to October 1st, imported.

Bareges (HAUTES - PYRENEES, FRANCE).—Sulphurous, warm. Sodium Sulphydrate and Sulphate, Sodium Chloride, Silica. Chronic rheumatism, skin and bone diseases. Imported.

Barium (LLANGAMMARCH WELLS, WALES).—Saline. A tumbler full three or four times daily. Sodium, Calcium, Magnesium and Barium Chlorides. Good organically. Only 0.0056 grs. per gallon of Albuminoid Ammonia. Contains no sulphates owing to presence of Barium. Heart affections glandular swellings, skin affections, rheumatism. Bottled, both aerated and still.

Bath. The only thermal spring in England, and one of the oldest in Europe. Recent improvements and accommodation.—B.M.J. ii./09157. King's Bath Spring.—Calcium Sulphate 102.88 grains, Sodium Sulphates 23.5, Magnesium Chloride 15.8 grains, per gallon, and other Salts in less proportion. Radium has been found in the waters and deposits, also Argon Helium, Krypton and Xenon.—Pres., May, 1911.

King's Well contains 0.1387 mgr. **Radium** per million litres. If the Niton* (emanation) were represented by the weight of Radium capable of forming the Niton present in a million litres of water or gas, the figures for the water of the King's Well, Cross Bath and Hetling Bath are respectively 1.73, 1.19, and 1.7 and for the gas from the King's Well 33.65. The gas from the King's Well contains about four times as much Niton as is contained in the natural gas from Buxton, viz., 7.7 and 8.5 mgr. per million litres.

A patient taking a bath probably absorbs some Niton through the skin and undoubtedly through the lungs. The skin absorption of Niton would be increased by connecting the patient with the negative pole of a battery (at a potential of 100 volts or even more) and placing the other pole in the bath. In a bath containing a cubic metre of Bath water there would be roughly one-thousandth of a milligram of Niton, which apparently is not a dangerous dose. Administration of stronger doses is possible with a spraying-machine, especially if natural gas be used for breaking up the fluid, when the potency would be nearly twenty times that of the water.—Sir Wm. Ramsay B.M.J. i./12,617, L. i./12,746; P.J. i./12,373. (See also SULIS, i.e., Bath water aerated and bottled).

Ben Rhydding. See **Ilkley**.

* **Bethesda** (WISCONSIN, U.S.A.).—Alkaline, Calc. and Mag. (T.M. 171394). Bicarbonates. Kidney diseases, Bright's disease, diabetes, torpid liver, dyspepsia, insomnia. Imported.

Birmenstorf (SWITZERLAND).—Saline aperient. Constipation, jaundice hæmorrhoids, uric acid. Imported.

Bonnes (see EAUX BONNES).

[P] Bourboule, La (PUY DE DOME, FRANCE), Choussy-Perriere Spring.—Arsenated, 1 litre=0.028 Gm. Crystallised Sodium Arsenate (1.9 grs. per gallon), Sodium Chloride and Bicarbonate. *Dose*.—A large tumblerful. gallon), Sodium Chloride and Bicarbonate. *Dose*, a large tumblerful. Debility, anæmia, chest affections, arthritis and diabetes.—B.M.J.E. i./06,06. Imported.

Brides-les-Bains (FRANCE).—Alkaline saline. Obesity, uric acid, constipation. Imported.

Description of resort and water. Closely analagous to the Sprudel Source at Carlsbad.—B.M.J. i./20,545.

Brucourt (CALVADOS, FRANCE). "Star" Spring.—Chalybeate. Tonic in anæmia. Imported.

Buffalo Lithia (MECKLENBURG CO., VA., U.S.A.).—(No. 2 the chief spring). Alkaline Lithiated table water. Albuminuria, uric acid diathesis, and other affections needing alkaline treatment. June 15 to October 1, and imported.

[P] Bussang (VOSGES, FRANCE).—Ferruginous tonic and digestive. Free Carbonic Acid, Sodium, Calcium, Magnesium Bicarbonates with Manganese, Iron and Arsenic. Anæmia, chlorosis, jaundice, gout, rheumatism, diseases of women. Season, 15th June to 15th September, and imported.

Buxton (DERBYSHIRE).—Slightly Saline. Sodium Chloride, Magnesium Carbonate, Calcium Carbonate, Free Nitrogen and Carbonic Acid. Stomach, bladder, liver, and kidney disorders, skin affections, gout, rheumatism, sciatica. All the year round and bottled. See also Table of Waters.

* Subsequent analysis by Sir W. Ramsay says Niton is present to the extent of 20×10^{-12} Cc. per litre—the largest proportion yet found in a mineral water. The **Durkheim** springs—the next richest yielding about $\frac{1}{4}$ this amount. The Radium Content now stated to be about 0.1 mgr. per million litres—which is about the same as Durkheim water.—P.J. ii./12,25.

The gentlemen's Natural Baths contain 1.1 mgr. per million litres of *Nitron*, i.e., about the same as the Cross Baths at Bath.—Sir Wm. Ramsay.—B.M.J. i./12,617; L. ii./12,746; P.J. i./12,373.

Valuable in alleviating chronic articular gout and rheumatism—irregular forms of gout are benefitted and acute attacks cut short. The mineral constituents only amount to 27 grains per gallon, chiefly Carbonates of Calcium and Magnesium, Sodium Chloride with traces of Iron and Manganese. The gases contained show a unique richness in Nitrogen. We have yet to learn why radio-active properties minister to gout and rheumatism. So far as is known radio-activity exerts a healthy active influence over metabolism.

★ **Cachat** (see EVIAN, Source Cachat).

Capvern (HAUTES PYRENEES, FRANCE).—2 springs; Houn-Caoude (drinking) and Bouridé (baths). Alkaline. Catarrh of bladder, gravel, gall stones, women's diseases. Season, May to October. Imported.

Carabana (SPAIN).—Purgative. Sodium Sulphate. Intestinal and hepatic affections and dyspepsia. Imported.

Cauterets (PYRENEES).—Sulphurous. Sulphuretted Hydrogen, Iodine. Skin and lung diseases, glandular swellings. Summer and imported.

Cerigo (GRECIAN).—Chalybeate. Imported.—Ph. Notes.

Challes (SAVOY).—Sulphurous. Chronic catarrh, skin affections and intestinal diseases. May to October. Imported.

Chateldon (PUY DE DOME, FRANCE).—Alkaline Acidulated. Stomach and urinary disorders, anæmia, and as a table water. Imported.

Chatel Guyon (AUVERGNE, FRANCE). Source Gubler.—Alkaline. Dyspepsia, jaundice, anæmia, constipation, uric acid. May to October. Imported.

★ **Cheltenham** (T.M.26137)—Pittville Waters: No.1 Chelt. Alkaline, Sodium Chloride, Sulphate and Bicarbonate; No. 2 less Sodium Chloride more Sulphate; No. 3 more Sodium Sulphate but less than No. 2; No. 4 **Cheltenham 'Magnesia'** (Magnes. Sulphate 117 grains per gallon) and Sodium Sulphate, No. 5 is No. 4 concentrated. No. 6 is Cheltenham Sodium Sulphate Saline, Sodium Sulphate in predominance. See also Table of Waters and P.J. ii./15, 571.

Claudia (SORGENTE DI ANGUILLARA, SABAZIA, near ROME).—Alkaline Carbonic Acid with small quantities of Alkaline Bicarbonates. Gastric dyspepsia. Imported.

Condal (RUBINAT, LERIDA, SPAIN).—Aperient, Sodium, Magnesium, Calcium and Potassium Sulphates, Sodium Chloride. As a purgative for habitual constipation, plethora, &c. Imported. See also Table of Waters.

Condillac (FRANCE).—Alkaline acidulated table water. Imported.

Contrexeville (VOSGES, FRANCE). Pavillon Spring.—Alkaline, Anti-rheumatic. Gouty affections, dyspepsia, eczema, catarrh of the bladder and liver. 20th of May to 20th of September, and imported. Contrexéville Source Mignon is also supplied. See also Table of Waters.

Dax (called locally La Néhe). Thermal—has temperature 61° C. Owing to evolution of Nitrogen appears to be boiling. Contains Sulphates and Chlorides of Calcium and Sodium. The mud contains a large proportion of living algæ—the *Oscillaria calida*. Is distinctly radio-active. In rheumatism. —B. & C.D. i./o6,67.

Desaignes (Eau de César) (ARDECHE, FRANCE).—Alkaline, Acidulated. Table water. Imported.

Dolecoed. See Llanwrtyd.

D'Orezza (CORSICA). Chalybeate table water. Anæmia, dyspepsia; useful after prolonged illness, or for weakness. 1st July to 1st September Imported.

Droitwich. See ★ **Wychia**.

Eaux Bonnes (BASSES PYRENEES, FRANCE).—Mild Sulphurous. Helium is given off by the water—due in all probability to radium-containing mineral at the source. Similar to Bareges and Cauterets. Bronchial catarrh, phthisis, neurasthenia, asthma. June 1st to October 1st, and imported

Has reputation of curing sterility in women. cf. Franzensbad.

Enghien-les-Bains (near PARIS).—Sulphurous. Lung and skin affections, uterine disorders, nervous diseases, nose and ear affections. Season, May 1 to Oct. 15. Imported.

Epidaurus (GRECIAN).—Imported.—Ph. Notes

***Esvach** (T.M. 224276).—Aperient. Magnes. Sod. and Pot. Sulphates and Bicarbonates, free Carbonic Acid. Habitual constipation, indigestion, biliousness, gout. Bottled.

Evian-les-Bains (HAUTE SAVOY) Sources "Cachat" and La Croix.—Alkaline table water. Calcium and Magnesium Bicarbonates, free Carbonic Acid. Liver and intestinal disorders. For washing out bladder in uric acid troubles; calculi, cystitis. May to October. See also Table of Waters.

Fango Mud Springs (ITALY).—Installation at Matlock. For the treatment of rheumatism.

Farris (Norske Mineralkilder, Larvik, Norway).—Mineral Table Water, radioactive, gout and rheumatic complaints.

Fiuggi (ITALY).—Saline. Sodium Chloride, Potassium Nitrate, Calcium Carbonate, Carbonic Acid, Ozone, and Oxygen (possibly due to action of radium emanations contained), Nitrogen. Gastric complaints. Imported. Full report on.—L. ii./07,915.

Flitwick (near AMPHILL, BEDFORDSHIRE).—Ferruginous Ferric Persulphate and Sodium Sulphate. Anæmia, chlorosis, dyspepsia, general debility and neuralgia. Bottled.

Folkestone contains about $2\frac{1}{2}$ to 3 grains of chalk per pint—if boiled about $\frac{1}{2}$ grain—which cannot be considered deleterious or have any bad effect. Folkestone water is exceedingly pure containing a trace only of Free Ammonia and 0.0008 grain per gallon of Albuminoid Ammonia. Total Hardness 18.7. Permanent Hardness 2.9 grains per gallon. Constipation is often produced by a visit to seaside towns. It is claimed that this is more likely due to climate and change than to effect of the water. Constipation is common amongst sailors who drink condensed water—it cannot in this case be ascribed to chalky water.—B.M.J. i./11,1430; L. i./11,1642, ii./11,158.

***Fontalis**.—A pure table water. Alkaline. Chlorides and Carbonates, free from Lime and Magnesium Salts. Bottled at Harrogate.

Forges (NORMANDY).—Chalybeate. Ferrous Bicarbonate. Chlorosis, dyspepsia. Season, June 1st to October 1st. Imported.

Gilgit (KASHMIR, INDIA).—Goitre does not occur among the coolies who drink the pure water of the Gilgit river. Total solids 7 grs. per gall. Total Hardness 4, Calcium about 6, free ammonia and organic matter nil.—L. ii./06, 1570

Grassion (FRANCE).—Bituminous. Throat and chest affections, gastric and vesical cattarrh. Imported.

Gytje.—A kind of mud from the Norway fjords used in the "Gytje" treatment in balneology for gout and rheumatism.—Ph. Notes.

Harrogate (YORKSHIRE).—Sulphurous. Skin and rheumatic affections, anæmia, dyspepsia. Aperient and diuretic. Summer and winter, and bottled. The Sulphur and Alkaline Carbonates compose half the solid ingredients. The Beckwith Spring contains large proportion of Magnesia. Helium has been traced in the gases rising, hence presence of Radium is assumed.—P.J. i./05,903.

Some pharmacological effects of the strong sulphur **Harrogate** water:—

A daily excess of urination was observed amounting to 42% when comparing two periods—11 days without and 11 days with. Similarly weight of fæces showed an increase of 245%. Total Nitrogen showed increase of 8%, Uric Acid 18%, Kreatinin 14%, Phosphates 10%. There is increased oxidation and tissue change, and general metabolism is greatly influenced. In some cases of gout the diminution of amount of urine passed (often under 20 ounces in 24 hours) is rapidly relieved—the diuresis amounting to over 100% and the sp. gr. of the urine does not vary inversely as the amount passed. Indeed, the sp. gr. is often highest at the height of the diuresis.—D. Brown. B.M.J. i./11,1304.

In a previous paper by the same author (B.M.J. ii./10,421) analogous conclusions were given. It may be added from this that exogenous purins excreted are increased. Excretion of endogenous Xanthin bases is decreased.

Sulphuretted Hydrogen content is 10.46 cubic inches per gallon.—B.M.J. ii./11,522.

Eczema, psoriasis, lupus erythematosus, furunculosis, urticaria, etc., treatment of, by the waters and baths at Harrogate.—B.M.J. ii./13,1019.

Harrogate Spa.—Description.—B.M.J. ii./19,78.

"**Harrogate Salts**."—Potassium Tartrate 360 grains, Magnesium Sulphate 1 pound, Sulphurated Potash 1 ounce.—P.J. i./07,548.

Hathorn (*see* SARATOGA).

Hypate (GRECIAN).—Sulphurous. Imported.—Ph. Notes.

Igmandi (KOMAROM, HUNGARY) Water. Radio-active. Saline aperient. Magnesium Sulphate 29·3, Sodium Sulphate 9·5, Calcium Sulphate 0·7, Sodium Chloride 0·8%. Total solids 40·8 per 1,000 Gm. Radio-activity inherent in the Calcium Sulphate.—L. ii./05,777. Corpulency, constipation, hæmorrhoids, rheumatism.

Ilkley and Ben Rhydding (ILKLEY in WHARFDALE). Chalybeate and Antacid. (i.) Chalybeate Spring. Ferrous Carbonate, Calcium Sulphate, and Alkaline Chloride. (ii.) "Hygeia" Spring. Calcium, Sodium and Magnesium Carbonates, Sodium Sulphate. (iii.) "Ilkley Wells" Gout and rheumatism.

Ilkley Wells (Old White Wells).—This water has recently been thoroughly studied by B. A. Burrell. The composition from the content of Acids and Bases would appear to be Ferric Oxide 0·0159 Calcium Carbonate 0·8078, Calcium Nitrate 0·014, Calcium Silicate 2·0535, Calcium Sulphate 0·5199, Magnesium Carbonate 1·4235, Magnesium Sulphate 1·09, Potassium Carbonate 0·1548, Sodium Carbonate 0·8726, Sodium Chloride 1·155, *Lithium Chloride* 0·0831 grains per gallon.—Yorkshire Geolog. Soc. 1914.

See also Health Resorts.

Kyllini (GRECIAN).—Sulphurous. Imported.—Ph. Notes.

Kythnos (GRECIAN).—Saline, Thermal. Imported.—Ph. Notes.

Labassere (HAUTES PYRENEES).—*See* Bagneres de Bigorre.

La Preste (EASTERN PYRENEES about 50 miles from Perpignan).—In affections of the urinary tract—cystitis, vesical catarrh, prostatitis, etc. Contains only 11·2 grains per gallon total solids. Silica one of the leading constituents.

Latraki (GRECIAN).—Alkaline.—Ph. Notes.

Leamington.—Saline. Calcium, Magnesium, Strontium and Barium Sulphates, Sodium, Calcium, Magnesium and Potassium Chlorides, Magnesium Bromide and Iodide, Calcium and Iron Carbonates with traces of Manganese and Titanium.—S. H. Smith, 1914. Dyspepsia, gout, women's diseases, sciatica, glandular swellings and skin diseases. Bottled. *See also* Table.

[P] Levico (AUSTRIAN TYROL).—Two springs (strong and mild); Arsenical chalybeate. STRONG: Arsenious Acid; 0·99 part per 10,000—1·12th of a grain per pint; the MILD is 1·10th of this. Further constituents: Ferrous Sulphate, and Ferric Persulphate. Anæmia, skin eruptions, neuralgia and amenorrhœa.

Llandrindod (WALES).—"Strong Sulphur," "Roman Spring," "Magnesium Spring." The first is radio-active. In skin affections, dyspepsia, glandular enlargements, gout, rheumatism. Season all the year round.

The Sulphuretted Hydrogen waters are of several strengths. One contains a small amount of thallium chloride and a considerable quantity of lithia—latter higher than Royat.—B.M.J. i./09, 1245.

Llangammarch.—*See* Barium.

Llanwrtyd, Dolecoed Spa (WALES).—Sulphuretted Hydrogen, the strongest in Great Britain.

Loueche (Leuk or Loeche les Bains) (VALAIS, SWITZERLAND).—Warm almost exclusively for baths. Calcium Sulphate, Magnesium Sulphate, similar to that of Bath in England. Rheumatism, gout, women's diseases, skin affections. 1st May to 15th October.

Magnaris.—A table water prepared at Llandrindod.

Malvern (WORCESTERSHIRE).—Practically free from saline matter, and contains no organic matter. Bladder and kidney diseases and skin affections. Bottled. *See also* Table.

***Malvern Selzer** (T.M. 4744 and 5).—Slightly saline table water.

Marcols (ARDECHE, FRANCE), Source du Lion.—Alkaline table water. Stomach, liver and kidney diseases, rheumatism. Imported.

Martigny (VOSGES). Lithiated. Gravel, diabetes, liver and kidney complaints.

Methana (GRECIAN).—Sulphurous.—Ph. Notes. So powerful as to render the place objectionable; the sea into which the water falls is milky, owing to the decomposition of the sulphuretted hydrogen. The bacterium *Beggiatoa nivea* is found in the sediment, and in the protoplasm of this organism particles of sulphur are distinctly visible under the microscope. Imported.

Miers (LOT, FRANCE).—Saline, laxative. Sodium Sulphate, Calcium Sulphate, Magnesium Chloride. Dyspepsia, calculi, migraine, obesity, albuminuria. Imported.

Missisquoi (VERMONT, U.S.A.).—Sulphurous. Scrofula and other skin affections, diseases of respiratory organs. Imported.

[P]Mont Dore (PUY DE DOME, FRANCE).—Alkaline, Saline. Bicarbonates, Ferrous Carbonate, Arsenic, and Silica. Intestinal disorders, rheumatism, asthma, bronchitis and laryngitis. June 1st to September 20th. Imported.

Montreux (SWITZERLAND).—Alkaline table water. Slightly mineralised. Stomach, liver, kidney and bladder affections. Imported.

Nocera Umbria (Angelica Spring, 185 kilometres from ROME).—Alkaline. Bicarbonates. Digestive, anturic, tonic refreshing. Imported

Orezza.—See **D'Orezza**.

* **Osmos** (T.M. 386477).—Mag. Sulph. (anhydrous) 1.73%, Sodium Sulphate (anhydrous) 1.79%, Sodium Chloride 0.16, Sodium Bicarbonate 0.18, Potassium and Calcium Salts—traces. Equivalent to Hunyadi Water.—B.M.J. ii./19,346. Used for constipation, dyspepsia, obesity, hæmorrhoids, liver and kidney disorders.

* **Perrier** (T.M. 287950 and 1). (VERGESE, nr. NISMES, FRANCE).—Slightly mineralised, organically pure. *Small* proportion of Alkaline Carbonates. Digestive. M.P., June 22/04.

Pistany (previously called Postyen).—A few miles from Vienna. Thermal mud baths, in rheumatic affections. For cases of sciatica and chronic periostitis also internal catarrhs.—B.M.J. i./20,545. Imported.

[P]Plombières (VOSGES, FRANCE).—Mild Saline. Sodium Sulphate, Arsenic, Oxygen, Nitrogen. Neurasthenia, gastralgia, dyspepsia, dilation of the stomach and chronic diarrhœa, rheumatism, skin affections. May to September. Imported. Mucous colitis treated by washing out the colon with the alkaline sulphur water and further bath treatment.—B.M.J. ii./0878. Radioactive.—Chem. News, Mar. 1/08, p. 132.

Poland (U.S.A.).—Potassium Sulphate, Sodium, Calcium and Magnesium Carbonate. In dyspepsia. Imported.

Postyen see **Pistany**.

Pougues (FRANCE).—St. Leger Spring.—Alkaline. Dyspepsia, anæmia, scrofula, gravel, catarrh of the bladder. May 15 to Sept. 30. Imported.

Pymont (WALDECK, WESTPHALIA). Three springs. HAUPTQUELLE contains most iron.—Chalybeate. Chronic catarrh, digestive and urinary diseases, women's diseases, scrofula, rheumatism and gout.

Quicherat (FRANCE).—Ferruginous. Magnesium and Sodium Chlorides, with some Iron and Manganese, Carbonic Acid. Anæmia, stomach diseases. Imported.

Ragatz-Pfäfers.—Canton St. Gall, Switzerland. Thermal Spring 99° Fahrenheit. Calcium, Magnesium, and Sodium Chlorides, Bicarbonates, and Sulphates. Very free from bacteria. Rheumatism, gout, sciatica, neuralgia May to October.

Recoaro (VENETIA, LOMBARDY).—Sources: Lelia, Lorgnia and Giuliana.—Ferruginous Table Waters. Sulphates. Intestinal and liver complaints. Tonic, easily assimilated. Summer and imported. ROYAL BITTER SOURCE.—Is pure bacteriologically. Purgative for intestinal complaints.

Rennine (REIPERTSWEILER, ALSACE).—Nitrated. Potassium Nitrate 0.19 Gm. per litre, Alkaline Chlorides. Diuretic, laxative, in heart disease.—L. ii./03,107

Renaion (FRANCE).—Alkaline, acidulated table water. Bicarbonates, free Carbonic Acid. Dyspepsia and gastric disorders. Imported.

[P]Roncègno (VALSUGANA, SOUTHERN TYROL).—Each litre contains 0.109 Gm. Sodium Arsenate, 0.115 Gm. Arsenic Anhydride, 0.03 Ferric Phosphate, 3.12 Gm. Ferric Sulphate, also Sulphates of Copper, Magnesium, Nickel and Cobalt.

Has the highest content of Arsenic in any spring, viz., 42.6 mgr. As_2O_3 per litre.—P.J. i./12,689.

In addition to 0.007% As_2O_5 , O. Bennett found 0.004% Antimony Oxide —P.J. ii./12,286.

Graves' Disease, 20 out of 37 cases completely cured.—B.M.J. ii./09,992.

[P]Royat (PUY-DE-DOME, FRANCE). Three Springs.—Saline, Arsenated (small quantity), Lithiated. Rheumatism, dyspepsia, nervous diseases, women's diseases, anæmia, skin affections and debility. Summer. Imported. Full description of this water.—B.M.J. i./07,758.

THE EXTRA PHARMACOPŒIA.

Rubinat (PYRENEES, SPAIN). "Llorach" Spring.—Aperient. Rich in Sodium Sulphate 9.62% and Magnesium Sulphate 0.32%, and contains Calcium Chloride. Stomachic disorders, constipation, liver and kidney affections. Imported. *See also* Table of Mineral Waters.

Rubinat (SERRE).—Similar to the last mentioned, but stronger than the above in the proportion of Sodium Sulphate to Magnesium Sulphate. Uses similar to the above. Imported.

[P] Saint Boès (BASSES-PYRENEES, FRANCE).—Bituminous, Iodised, and Arseniated. Arsenic, Iodine. Skin, lung, and venereal diseases. Imported.

Saint Galmier (LOIRE, FRANCE).—"Badoit" Table water. Dyspepsia, intestinal catarrh, constipation, nervous disorders, hyperæmia. Imported. "Noel"—Alkaline. Acidulated. Uses as latter. Imported.

Saint Gervais (HAUTE SAVOIE).—Saline. Sodium and Calcium Sulphates, Sodium Chloride. Skin affections, constipation, rheumatism and nerve diseases. 15th May to 30th September. Imported.

Saint Moritz (SWITZERLAND). "Paracelse" Spring.—Alkaline, Chalybeate, Tonic. Nervous and intestinal disorders, sick headache, hysteria, Graves' disease and for convalescence. All the year round. Imported.

Saint Sauveur—*See Vernet les Bains.*

Salies de Bearn (FRANCE).—Saline. Sodium Bromide and Iodide. Skin affections and as a general tonic.

Salins les Bains (JURA, FRANCE).—Tonic. Magnesium Chloride, Iodides and Bromides. Anæmia, tuberculosis, general debility, women's diseases, obesity, and scrofulous affections. Summer. Imported.

Sallyco.—Artificial. Is stated to contain Colchicine and Salicylic Acid.

*** Salutaris**—Still and aerated table water, distilled water. For washing out the system in kidney and liver disorders, also gout and dyspepsia.

San Pellegrino (near MILAN).—Diuretic Calcium and Magnesium Sulphates, some Carbonate with trace of Chloride, also Lithium. Mineral Salts amount to 1.264 Gm. per litre.—L. i./c9,43.

Saratoga (U.S.A.). "Congress" and "Hathorn" springs.—Alkaline, Saline. A mild aperient in dyspepsia, skin affections, diseases of the stomach, liver, kidney, and blood, constipation. Imported.

Slanic Spa (ROUMANIA).—Rich in Carbonic Acid, Alkaline. Stimulates secretion by content of Sodium Chloride. Neutralises excess of Hydrochloric Acid by the alkali (Sodium Bicarbonate).—B.M.J.E. i./11,40.

Soulac-sur-Mer (MEDOC, GIRONDE, FRANCE).—Health resort. Sea air.

Spa (BELGIUM).—Ferruginous. Anæmia, uterine and nervous disorders, rheumatism, gout. Summer, and imported.

Strathpeffer.—*See British Health Resorts*

*** Sulis** (Bath Water, aerated).—Aperient table water. Calcium and Sodium Sulphates, Magnesium and Sodium Chloride. Gives a radio-active emanation

Tansan.—A Japanese water, radioactive. Radioactivity stated to be 31 Mache Units. A tonic table water. Imported.

Tarasp (SWITZERLAND). St. Lucius Spring.—Alkaline, Saline. Diuretic. Useful in chronic catarrh of the stomach, dyspepsia, gastralgia, habitual constipation, disorders of nutrition, obesity. 1st June to 15th Sept. Imported.

Thonon (LAKE LEMAN, FRANCE). Alkaline, Carbonated and Benzoated (Balsamic resins are contained). In liver complaints and urinary diseases. Imported bottled.

Tonalka. An alkaline tonic aperient water. Supplied in syphons and bottles.

Trefriw Wells near Llandudno, contain iron in ferrous state. One well showed iron in this form equivalent to 2.21 grains per ounce of crystalline ferrous sulphate, the other 1.42 grains. Dose, $\frac{1}{2}$ ounce twice daily.—B.M.J. i./19,712.

Tsagesi (GRECIAN). Chalybeate.—Ph. Notes.

Uriage.—Waters considered to facilitate absorption of Mercury.—D. Freshwater, Pr., Mar., 1912.

Vals (ARDECHE, FRANCE). Springs: Madeleine, Précieuse, Désirée, Rigolotte, St. Jean.—Alkaline, acidulated. (Contents vary with the spring.) Rheumatism, anæmia, skin affections. Imported.

Vernet-les Bains (PYRENEES ORIENTALES).—Sulphate. Sodium Sulphate and Thiosulphate. Constipation, skin affections, anæmia. May to October, and imported.

★ **Vichy** (ALLIER, FRANCE). Springs: Grande Grille, Hopital, Célestins, Parc.—Alkaline, acidulated. Gravel, chronic urinary affections, diabetes, female complaints, gout, rheumatism, facilitates digestion. May 15th to September 30th, and imported.—M.P., Aug. 26, 1903

For renal elimination but does not appeal to English visitors.—L. ii./09, 1276.

Villacabras (SPAIN).—Saline aperient. Sodium Sulphate. Obesity and constipation. Imported.

Analysis shows Sodium Sulphate 78·51, Sodium Chloride 1·05, Magnesium Sulphate 2·74, Calcium Sulphate 1·70 Gm. per litre. Replaces bitter waters of Germany, Austria and Hungary.—L. ii./15, 184.

Vittel (VOSGES, FRANCE). Spring: Grande Source.—Alkaline. Sodium and Magnesium Bicarbonates, Sodium Calcium, and Magnesium Sulphates, Carbonic Acid. Uric acid, scrofula, chlorosis, biliary and urinary congestion. In addition are Source Salée, stronger in Magnesium Sulphate; Source Marie and Source des Demoiselles, Chalybeate. The first two are imported.

Aortitis relieved, pain becoming less frequent. Dyspnœa practically disappeared by a course at Vittel.—B.M.J. ii./08, 80.

¶ **Woodhall** (LINCOLNSHIRE).—Saline, Bromo-iodised. Bromide, Iodine (free and combined), Sodium Chloride, Arsenic. Gout, sciatica, rheumatism, skin affections, goitre, women's diseases.

A large range of diseases from arthritis to eczema may be treated on orthodox principles.—L. i./09, 1478.

★ **Wychia** (T.M. 274130) (DROITWICH).—Saline. Sodium Chloride 11·93 and Sulphate 7·89 per litre. Droitwich water is distinctly radio-active. Laxative habitual constipation and plethora.—L. i./06, 38.

Droitwich Brine Baths have no equal for treatment of sciatica and allied affections. Even rheumatoid arthritis is certainly improved and in some cases actually cured. The cures of chronic sciatica are most striking.

Analysis of the brine has shown it to contain 20,000 grains per gallon of saline constituents in excess of that possessed by any other known water. The actual figures are: Chloride of Sodium, 21761·8; Chloride of Magnesium, 2·5; Sulphate of Lime, 91·1; Sulphate of Alumina, 14·4; Sulphate of Soda, 342·7 Iodide of Sodium 0·208; total salts to an imperial gallon, 22212·8.

The brine acts possibly by absorption through the skin because the acidity of the urine is diminished, the output of uric acid being eventually lessened. Patients soon remark the change of colour in their urine, and the absence of pink deposit so well known in lithæmia. Urates are increased at first, and afterwards, as the urine becomes alkaline, they become diminished. The brine acts as a powerful uric-acid solvent. The radium emanation contained has something to do with this. Wonderful results in neurasthenia. Certain diseases are aggravated by the brine, e.g., malignant disease. The brine will cure almost every variety of uric-acid disease, both those belonging to the collæmic, and also to the arthritic group.—Jl., R.A.M.C., July, 1911.

A Table of certain Mineral Waters showing their Approximate Contents in Grains per Pint.

In the following Table we have arranged a brief list of some of the waters, giving their principal constituents from various published analyses. It occurred to us that an arrangement of this kind would be of interest as enabling the physician to see at a glance the relative **proportions of the various main elements** and the forms in which they occur in the waters. The Salts showing the higher quantities take precedence in each column.

As an after-war note we may say the table contains details of numerous foreign waters. The information is valuable for reference. Needless to say, Medical Men are urged to refrain from recommending foreign spas—on the contrary the British equivalents should take precedence wherever possible.

SPRING.	CHARACTER.	CARBONATES (more or less in form of Bicar- bonates).	CHLORIDES.	SULPHATES.	OTHER CONSTITUENTS and authority.
Æsculap	Saline Aperient.	Sodium, $8\frac{3}{4}$	Sodium, $25\frac{1}{2}$	Magnesium, $151\frac{1}{4}$. Sodium, $121\frac{3}{4}$. Calcium, $18\frac{1}{4}$. Potassium, $2\frac{3}{4}$. Sodium, $1\frac{1}{2}$.	Traces of Alumina, Iron, Man- ganese.—J. Molnar.
Aix-la-Cha- pelle	Saline Sulphurous. (Kaiser Brunnen) Table Water is similar.	Sodium, $6\frac{1}{4}$. Calcium, $1\frac{1}{2}$. Magnesium, $\frac{1}{2}$	Sodium, $25\frac{1}{2}$.	Magnesium, $184\frac{1}{2}$. Sodium, 164 . Calcium, 23 . Potassium, $\frac{3}{4}$. Lithium, $\frac{1}{2}$.	Traces of Sulphides, Iodides and Bromides, Lithium, Iron and Strontium.— Baron Liebig.
Apenta	Saline Aperient.	Sodium, 4. Magnesium, $1\frac{1}{2}$. Calcium, 1. Ferrous, $\frac{1}{2}$.	Sodium, $15\frac{1}{2}$.	Magnesium, $184\frac{1}{2}$. Sodium, 164 . Calcium, 23 . Potassium, $\frac{3}{4}$. Lithium, $\frac{1}{2}$.	Traces of Bromide, Alumina, etc.—R. C. Tichborne,
Apollinaris	Table Water.	Sodium, $\frac{1}{2}$. Magnesium, $3\frac{1}{4}$. Calcium, $2\frac{1}{4}$.	Sodium, 31.	Sodium, 2.	CO ₂ (Free) $24\frac{1}{4}$.—Apolli- naris Co.

SPRING.	CHARACTER.	CARBONATES (more or less in form of Bicar- bonates).	CHLORIDES.	SULPHATES.	OTHER CONSTITUENTS AND AUTHORITY.
Bath	Table Water.	Calcium, 1.	Magnesium, 2. Sodium, 2.	Calcium, $11\frac{3}{4}$. Sodium, 3. Potassium, 1.	Traces of Iron, Ammonia, Nitrates. See also p. 435.
Buxton (St. Anne, Ther- mal)	Slightly saline gas- eous table water.	Calcium, $1\frac{3}{4}$. Magnesium, $\frac{3}{4}$.	Sodium, $\frac{1}{2}$. Ammonium, $\frac{1}{4}$. Magnesium, $\frac{1}{4}$.	Sodium } Potassium } Calcium } $\frac{1}{4}$.	Traces of Iron, Manganese and Barium. Sulphates. See also p. 435.
Buxton (Chalybeate)	Chalybeate	Ferrous, $\frac{1}{2}$. Magnesium, $\frac{1}{4}$.	Sodium, $\frac{1}{4}$.	Calcium, $1\frac{1}{4}$. Magnesium, $\frac{1}{2}$ Sodium, $\frac{1}{4}$.	Traces of Aluminium and Potassium Salts.
Carlsbad (Sprudel)	Alkaline	Sodium, $11\frac{1}{2}$. Calcium, 3. Magnesium, $1\frac{1}{2}$.	Sodium, 9	Sodium, 21. Potassium, $1\frac{1}{2}$.	Traces of Lithium, Stron- tium, Aluminium and Fluorine Compounds.— Prof. E. Ludwig and J Mauthner.
Cheltenham	Saline Aperient	Calcium, $4\frac{1}{2}$.	Sodium, 3.	Magnesium, $14\frac{3}{4}$. Calcium, 8. Sodium, $7\frac{1}{2}$. Potassium, $\frac{1}{2}$.	Traces of Alumina, Iron, Manganese, Bromides, Io- dides, Phosphate.
Condal	Aperient	—	Sodium, $16\frac{1}{4}$.	Sodium, 390 $\frac{1}{2}$. Magnesium, 27. Calcium, $14\frac{1}{2}$. Potassium, $4\frac{1}{2}$.	Traces of Alumina, Iron.— Ecole Nat. des Mines, Paris.

SPRING.	CHARACTER.	CARBONATES (more or less in form of Bicar- bonates).	CHLORIDES.	SULPHATE.	OTHER CONSTITUENTS AND AUTHORITY.
Contrexeville (Pavillon)	Alkaline.	Calcium, 3½. Magnesium, ¼.	—	Calcium, 13½. Sodium, 2. Magnesium, ¼.	CO ₂ ½; (Le Cler Spring 10). Traces of Arsenic, Chlorides Fluorides.
Ems (Kranchen)	Alkaline Saline.	Sodium, 8½. | Calcium, 2. Magnesium, 1½.	Sodium, 8½.	Potassium, ½. Sodium, ¼.	CO ₂ and traces of Alumin Barium, Iron, Manganese, Strontium, Phosphate.— Frenseius.
Evian-les- bains (Cachat)	Akainen.	Calcium, 1¼. Magnesium, ¾.	—	—	CO ₂ and traces of Iron Magnesium, Sodium, Chlor ide, Nitrate, Phosphate.— Willm, Lille.
Franz Josef	Aperient.	—	Magnesium, 14½.	Magnesium, 216½. Sodium, 211. Calcium, 16½.	CO ₂ 9½ total. Traces of Alumina, Iron.— Attfield.
Friedrich- shall	Saline Aperient.	—	Sodium, 69½. Magnesium, 43	Magnesium, 54½. Sodium, 45½.	Municipal Chemists of Brealus. Fischer's analy- sis shows double quantity of Mag. Sulph. and no Sod. Sulph.
Harrogate	Sulphurous, <i>vide</i> p.437	—	—	—	—
Hunyadi Janos	Aperient.	Sodium, 8. Strontium, ¼.	Sodium, 15. Calcium, 9.	Sodium, 197½. Magnesium, 195½. Potassium, 1.	CO ₂ Trace of Iron.
Johannis	Alkaline, Table.	Calcium, 6½. Sodium, 3¼. Magnesium, 2½.	Sodium, 9.	Sodium, ¼.	CO ₂ (Free) 21½. Traces of Iron, Lithia, Man- ganese and Potash.

SPRING.	CHARACTER.	CARBONATES (more or less in form of Bicar- bonates).	CHLORIDES.	SULPHATES.	OTHER CONSTITUENTS AND AUTHORITY.
Leamington	Saline.	Calcium, $\frac{1}{2}$ Iron, $\frac{1}{10}$.	Sodium, 109 Calcium, 5. Magnesium, 4. Potassium, 1.	Calcium, $21\frac{3}{4}$. Magnesium, 11	Lithium, Manganese, Tit- anium, Iodine, Bromine S. H. Smith, 1914.
Malvern Vide List of Waters	Table.				CO ₂ . Lime, Magnesium, Sodium, Chloride, Iodide, (Total = $\frac{3}{4}$ gr. only).
Marienbad (Kreuz- brunnen)	Alkaline chalybeate.	Sodium, $15\frac{1}{2}$. Calcium, $8\frac{1}{4}$. Magnesium, $6\frac{3}{4}$. Ferrous, $\frac{1}{2}$.	Sodium, 14	Sodium, $45\frac{1}{4}$. Potassium, $\frac{1}{2}$.	Traces of Alumina, Lithia, Manganese, Strontium.— Kersten. Ferdinand's-brunnen is a little stronger in Potash and Soda Salts.
Nauheim (Karls- brunnen)	Mild Saline Aperient.	Calcium, $4\frac{1}{4}$.	Sodium, 48. Calcium, $3\frac{1}{4}$. Potassium, $1\frac{1}{2}$. Magnesium, 1; Sodium, 18.	Potassium, $6\frac{1}{2}$.	CO ₂ (Free) $14\frac{1}{2}$. Others, <i>vide antea</i> .
Rubinat (Llorach)	Aperient.	—		Sodium, $84\frac{1}{4}$. Magnesium, 28; Calcium, 17.	Traces of Alumina, etc.— Bouchardat.
St. Galmier (Romaines)	Table.	Calcium, 10. Potassium, 8. Magnesium, $7\frac{1}{4}$. Sodium, 6.	Sodium, $\frac{3}{4}$. Calcium, $\frac{3}{4}$. Magnesium, $\frac{1}{4}$	Calcium, $\frac{3}{4}$. Magnesium, $\frac{1}{4}$. Sodium, $\frac{1}{4}$.	CO ₂ (Free) $20\frac{1}{4}$, Alkaline Silicates $\frac{1}{2}$, Traces of Arsenic, Phosphorus and Iodine. "Badoit" and "Noel" contain about a $\frac{1}{4}$ and $\frac{1}{8}$ respectively of total saline matter of "Romaines."

SPRING.	CHARACTER.	CARBONATES (more or less in form of Bicar- bonates).	CHLORIDES.	SULPHATE.	OTHER CONSTITUENTS AND AUTHORITY.
Vichy (average of the three springs).	Alkaline, Acidulated.	Sodium, 2½. Calcium, ¼.	Sodium, ¼.	—	CO ₂ ½. Traces of Potassium, Arsenic, Boric Acid, Iron, Manganese and Magnesia.
Vittel (‘Grande Source’)	Sulphated Ferruginous.	Calcium, 1½. Magnesium } Sodium } ¾	Sodium } Magnesium } 2. Potassium }	Calcium, 4. Magnesium, 3½. Sodium, 3.	Traces of Iodine, Arsenic and Iron.

BRITISH HEALTH RESORTS.

Bath.—Climate mild and equable. Mineral springs. Suitable for gout and rheumatism.

Ben Rhydding (*see also Ilkley*).—Bracing. Medicinal springs. Suitable for gout, rheumatism, &c.

Blackpool (Lancashire).—Very bracing. During convalescence.

Bournemouth.—Mild and dry. Sand and gravel soil. 100 ft. above sea-level; protected from N. and E. winds by pine woods. Suits persons coming home from the tropics, and for respiratory diseases.

Braemar.—Mountain Health resort. Very bracing climate. Sandy and gravel soil. 1,100 feet above sea level. Suitable for neurasthenia and convalescence from influenza, etc. Season June to Oct.

Bridge of Allan.—Mild and equable. Saline springs. Suitable for consumption, bronchial affections, gout, rheumatism, &c.

Buxton.—Highest town in the Kingdom. Thermal springs. Suitable for gout, rheumatism and paralysis.

Channel Islands (Jersey, Guernsey, and Alderney).—Climate fine and healthy. Even temperature. Suitable for all pulmonary troubles and neurasthenia.

Cheltenham.—Spring, autumn and winter resort. Chalybeate and saline waters. Suitable for respiratory diseases.

Clifton.—Climate equable. Alkaline waters. Suitable for respiratory diseases, also diabetes, liver and urinary disorders.

Cromer.—Climate very bracing, often too cold in spring; cool in summer. Suitable for anæmia, scrofula, nervous affections, and convalescence.

Deal.—Very bracing, pebble beach, not fit for bathing; suitable for rest cure, nervous and chronic cases.

Droitwich—Recommended for its Brine Baths, which are efficacious in rheumatic and gouty affections, congestion of liver and spleen and nervous debility (*See Wychia Water*)

Eastbourne.—Good sea bathing; suited for convalescents from September to January, especially for cases of scrofula and consumption.

Exmouth.—The old town high and windy; the new town beside the river and sea beach is more protected, mild and humid.

Falmouth.—A warm equable winter climate; a rival to the Riviera, and cool in summer.

Folkestone.—Bracing. For Analysis of Water *vide* Mineral Waters.

Freshwater Bay.—Isle of Wight. Southern aspect for convalescents and consumptives.—B.M.J. i./o6,990.

Harrogate.—Has Sulphur, Chalybeate, and other Saline Springs. *See* Mineral Waters.

Hastings.—Mild, being suitable as winter resort for convalescents. Many cases of phthisis receive benefit from this climate

Ilfracombe.—Bracing for recovery from illness.

Ilkley (*see also Ben Rhydding*).—Bracing moorland air; good fishing; golf links; a hilly district.

Leamington Spa.—Equable climate. Saline Springs. Suitable for chronic liver and kidney complaints, dyspepsia and uterine congestion.

Llandudno.—Climate bracing and appetising; rather windy; a good place for summer health resort.

Llandrindod Wells.—Bracing climate. Thermal waters. Suitable for liver complaint, rheumatism, skin diseases. (*See also* Mineral Waters) 700 feet above sea level.

Malvern.—Bracing air; equable climate. Brine and Saline Baths. Suitable in gout, rheumatism, scrofula, &c. (*See also* Mineral Waters.)

Margate.—Equable cool temperature, dry sub-soil, and a moderate altitude. Suitable for convalescence and lung complaints, and especially for gland enlargements and tuberculous joints; a very bracing climate.

Matlock Bath.—Thermal and Mineral Springs. There is here a Fango di Battaglia (hot volcanic mud cure) installation. Suitable for rheumatic and gouty affections.

Penzance.—A mild, equable, warm climate, but not much shelter from winds.

Scarborough.—Exceedingly bracing. Moors in vicinity. Suits nervous hypochondriacal persons and those recovering from illnesses.

Sidmouth(Devon).—Climate particularly favourable in catarrhal, bronchial and cardiac affections. In phthisis.—B.M.J. i./o6,990.

Scilly Isles.—Mild and humid climate, temperature varying less than at any other watering place in Britain.

Southport (Lancashire).—Fine sands, bracing climate, suitable for laryngeal and pulmonary diseases.

Strathpeffer Spa.—Strong sulphurous (4 springs, richest in sulphur compounds of any in Great Britain), also an effervescing chalybeate spring. Suitable for rheumatism, gout, liver and skin diseases.

Torquay (Devon).—A summer pleasure season, hot and very humid, and a warm winter season; has a mild and equable climate, the soil quickly drying. Suitable for all pulmonary complaints.

Tunbridge Wells.—The old town, much sheltered, lies in a warm valley, while houses on the hills around have a bracing climate.

Ventnor and Weymouth.—Winter health resorts. Have reputation for phthisical sufferers.

Weston-super-Mare.—A mild equable climate; the town sheltered by hills on the north and east; fine sand and plenty of ozone; the tide recedes a great distance.

See also 'MEDICAL DIRECTORY.'—Churchill, London—for further details.

For a good treatise on the subject, beautifully illustrated, see "HEALTH RESORTS OF THE BRITISH ISLANDS," by Neville Wood.

IRISH HEALTH RESORTS.

Kingstone, Killiney, Greystones, Bray.—Mild and dry, comparing with Hastings and Ventnor.

Tramore in Waterford.—Magnificent sandy beach.

Queenstown.—A suitable winter health resort, well protected from N. and E. winds.

Glandore, Glengariff, Parknasilla are similar.

Sulphuretted water at **Lisdoonvarna**(5.55), **Lucan** (2.7), **Donegal** (8.29), **Ballynahinch** (3.35 Cc. per litre). These are much stronger than Harrogate water in H_2S .

Mallow (70°) is the only warm spring in Ireland.

For several others B.M.J. ii./o7,1583 should be consulted.

See also 'MEDICAL DIRECTORY.'—Churchill, London—for further details

Advantages of British Health Resorts for Foreign Invalids

Hitherto the movement of invalids has been in one direction only. Value of our climatic conditions and maritime resorts.—Neville Wood, Int. Cong of Med., 1913.—B.M.J. ii./13,542; L. ii./13,809.

MILK ANALYSIS.

Average Chemical Composition of Milk of good quality :—

	Per cent.	
Water	87.75	
Fat	3.50	
Casein	3.20	
Sugar	4.40	} Solids-not-Fat
Albumin	0.40	
Ash	0.75	

Milk also contains small quantities of Citric Acid and Enzymes. (See Enzyme Table.)

The following data are necessary to determine quality of a specimen.

- (1) **The Specific Gravity** may be determined by a Specific Gravity bottle or Lactometer; the average reading is 1.031.

N.B.—Low gravity may indicate added water, or in some instances richness in fat.

- (2) **To determine Total Solids.** Evaporate 5 Gm. of the specimen on a water bath in a tared platinum capsule; the residue, which should be nearly white, averages 12.8%. Minimum: 11.5%.

- (3) **Fat.** Two determinations at least should be conducted, particularly if the figure for the non-fatty Solids is to be taken as the difference between the Fat result and that of the Total Solids. The following method is convenient:—

Shake the milk and place 10 Cc. of same in a Schmidt tube (graduated to 50 Cc.) and provided with a cork. Add 10 Cc. Hydrochloric Acid. Heat corked 10 minutes on water-bath shaking occasionally; then cool rapidly under water stream, when quite cold fill the tube to 50 Cc., mark with ether (pure). Insert cork and shake vigorously 1 minute, allow to separate and read off the volume of ether. Remove 2 separate 10 Cc. and evaporate in tared dishes. Take the mean and calculate % of fat. *It must not be less than 3%,—vide infra.*

(With regard to this 3% Milk Fat Standard it is known that the yield from the same cow may vary greatly, *e.g.*, it may be $2\frac{1}{2}\%$ in the morning and as high as $4\frac{1}{2}\%$ in the afternoon. The milking should be done at equal 12 hour intervals as far as possible.)

Cream in normal milk is about 10% varying with season, pasture, etc.

Milk that has been adulterated with water throws up its cream readily. **Refrigeration of Milk** prevents cream rising. Milk that has been **Pasteurized** will not throw up its cream at all.

Non-fatty Solids.

Are determined by subtracting the fat content from the Total Solids. *Must not be less than 8.5%.*

Lactose, or Milk Sugar Estimation (Average content 4%).

Dilute 50 Cc. of sample with water 150 Cc., add a few drops of Acetic Acid to throw out Casein and Albumin, boil for a short time and after cooling make up to 250 Cc., finally allow to stand and filter. 5 Cc. of the filtrate represent 1 Cc. of the original milk. Into 5 test tubes marked '1' to '5' place 5 Cc. of freshly mixed Fehling Solution: dilute with an equal volume of water and add from a burette to '1' 3 Cc., to No. '2' 3.5 Cc., to No. '3' 4 Cc., to No. '4' 4.5 Cc., to No. '5' 5 Cc. of the above filtrate, place on a sand bath and boil for six minutes. According to the colour of the supernatant fluid in the tubes one notes whether the reduction is complete. It may be necessary to repeat the test, using intermediate quantities, *e.g.*, 4.1, 4.3, &c., Cc. of the filtrate. The calculation is on the following lines:—

In an experiment 4.15 Cc. of the filtrate were necessary. 1 Cc. of Fehling Solution = 0.00675 Gm. Lactose. \therefore 4.15 Cc. Filtrate = 0.03375 Gm. Lactose, *i.e.*

$$\frac{4.15}{5} \text{ Cc. Milk} = 0.03375 \text{ Gm. Lactose.} \therefore 100 \text{ Cc. Milk} = \frac{0.03375 \times 5 \times 100}{4.15} = 4.07 \text{ Gm Lactose.}$$

Lactose Determination by Polarimeter:—

Add to 60 Cc. of the Milk 10 Cc. of a solution of Mercury in twice its weight of Nitric Acid 1.43 diluted with four times its volume of water. Make volume up to 102.4 Cc., filter. Note rotation in 200 m.m. tube,—divide by 2 and by 53 the specific rotation for lactose. Result is the amount of lactose per Cc. in the solution. Multiply by 100 to give the amount in 60 Cc.—P.J. ii./04, 850.

Mineral Matter of milk can be obtained by igniting the milk solids, and usually averages 8.3% of them.

N.B.—A dilution of normal milk with water will reduce the ash almost proportionately to quantity of water added, so the combination of a low ash and low non-fatty solids point strongly to addition of water.

Casein Estimation (Average content 3.2%).—Dilute 20 Cc. of the sample with 300 Cc. water, and add strong acetic acid drop by drop to complete precipitation. Pass in carbon dioxide for 20 minutes, collect the casein and fat on a weighed filter paper; wash thoroughly with, firstly, alcohol, then ether to remove fat (well conducted in a Soxhlet thimble on water bath), dry and weigh.

Many proteins are precipitated by Acetone. Weyl applied this property to estimation of the Proteins in cow's milk and in fresh bullock's blood and obtained concordant results. The milk or blood is diluted with equal volume of water and poured into four volumes of Acetone. The precipitate is collected, washed with equal volumes of Acetone and Water then with Alcohol and is finally extracted with Ether in a Soxhlet apparatus, dried and weighed.—J.C.S.A. j./10, 287.

A new protein has been found in milk resembling the gliadin of wheat in its solubility in 50 to 80% Alcohol. Several previously described proteins have been more definitely characterised.—*Abst. Ann. Rep. Chem. Soc.* 1919 (Vol. XV.), p. 193.

Lecithin contained in various milks. Human, average, 0.0499%, cows 0.0629%, asses' 0.0165%.—*P.J.* ii./08,840. See also p. 88.

The **Average Constituents** of good milk (as stated at the commencement of this chapter) are **affected by the addition of water** as follows:—

			Genuine Milk.	
Percentage of Fat	..	..	3.50	
" " Solids-not-Fat	..	..	8.75	
Milk with added Water.			Fat.	Solids-not-Fat.
95% milk, 5% water ..	..	..	3.32	8.31
90% milk, 10% water..	..	..	3.15	7.87
85% milk, 15% water..	..	..	2.97	7.43
80% milk, 20% water..	..	..	2.80	7.00
75% milk, 25% water..	..	..	2.62	6.56

COLOSTRUM.—The milk from mammals shortly after birth of their young differs from normal milk in containing a very high percentage of an albumin closely resembling blood albumin. The proteins it contains are soluble. Colostrum provides readily absorbable nutriment, as the infant's stomach contains no gastric juice at the commencement. It is highly laxative in properties, probably owing to its high fat content.

The fat content of the faeces of the infant is always high—ranging from 10 to 20%—during the first week it is as high as 40 to 50%.

The salts in human and cow's milk vary very greatly. Nearly $\frac{1}{2}$ of the salts of cow's milk are alkali citrates and alkali earth citrates. Human milk contains 0.5 Gm. of Citric Acid as citrates, whilst cow's milk contains from 1 to 1.5 Gm. per litre.

The proteins of Milk consist almost entirely of Casein and Albumin. Analyses show mean percentages as follows:—

		Albumin.		Maximum.	Minimum.
		Casein. ('Lactalbumin.')	Albumin.		
Cow's Milk	..	6	1	7 to 1	4.5 to 1
Goat's "	..	3	1	3 to 1	2 to 1
Sheep's "	..	3	1	4 to 1	3 to 1
Mare's "	..	1.5	1		
Asses' "	..	1	2.3		
Human "	..	1	1		

The proportion of these two forms of Protein is adjusted to the needs of the animal, the albumin being easily digested, and the casein digested with difficulty. A sixteen pound infant requires more casein than one weighing 12lbs. though of the same age, and the human milk changes accordingly. More and more casein and less and less albumin is required by the child as time goes on.—*Am. Jl. Ph.*, Feb./08,55. *c.f.* *Whey Powder*, Vol. I., pp. 573, 574.

The milk supplied in this country in a large proportion of cases is from cows in calf. That from cows not in calf is more digestible, as the drain of the embryonic calf interferes with quality of the pregnant cow's milk.

The **Board of Agriculture** in 1901 issued certain '**Sale of Milk Regulations**' which require a minimum of 3% milk fat, also at least 8.5% milk solids other than fat. Skimmed or separated milk to have at least 9% milk solids.

The following figures show how, taking the so-called "**Government**" definition of genuine milk, the fat and solids-not-fat would be affected **by the addition of water**:—

			Genuine Milk. (Government Standard).	
Percentage of Fat	..	..	3.00	
" " Solids-not-Fat	..	..	8.50	
Milk with added Water.			Fat.	Solids-not-Fat.
95% milk, 5% water ..	..	..	2.85	8.07
90% milk, 10% water..	..	..	2.70	7.65
85% milk, 15% water..	..	..	2.55	7.22
80% milk, 20% water..	..	..	2.40	6.80
75% milk, 25% water..	..	..	2.25	6.37

—*Brit. Food Jl.*, March, 1916

Taking advantage of the exceedingly low standards laid down by the Board of Agriculture it appears that farmers are making an additional profit by toning down milk with skimmed or separated milk so as to keep the fat content just within the standard. Suggestion that this should be overcome by revision of the Regulations.—B.M.J. ii./10,1178.

Milk and Dairies Bill introduced into the House of Commons by Mr. J. Burns. Provisions for more effective registration and inspection of premises used by milk traders, prohibition of milk likely to cause infectious disease (including tuberculosis). Registration to be made compulsory.—L. ii./12. 1735,1762. Prof. Delépine's Criticisms.—L. i./13,343.

A Bill is before Parliament to amend the Milk and Dairies (Consolidation) Act of 1915—a measure to save what might be saved of the Milk and Dairies Acts of 1914.—See L. ii./20,957,969. For the latter, see L. i./14,1474.

A Milk Bill added to the Tuberculosis Order is essential if we are to make any real headway in warfare against surgical tuberculosis. Stamp out bovine tuberculosis.—H. J. Stiles, B.M.J. ii./13,371.

Milk Supply Control by clean milking, etc. Necessity of adopting Bang's method,—i.e., to isolate in a farmer's herd those cows afflicted with tuberculosis and to feed the calves of those born of diseased mothers with the milk of those not affected and to continue so as to raise a non-tuberculous herd.

Farmers should be forced by legislation to more sanitary measures. Highly unsatisfactory condition of London's supply.—W. Colingridge, M.O.H. City of London, L. ii./13,822.

For the legal requirements as to Butter, Cream, etc., "The Law and Chemistry of Foods and Drugs," Robinson and Cribb (Rebman) may be consulted.

Grade 'A' Milk under licence of Food Controller is produced under clean and hygienic conditions from a herd free from tuberculosis.

Grade 'A' Certified Milk is similar, with additional precautions. It is bottled after cooling on the producer's premises in sterilised bottles and labelled. It must not contain *B. Coli* in 1/10 Cc. or more than 30,000 bacteria per Cc.—B.M.J. i./20,336.

The Sale of Food and Drugs Act, 1875-1899, enforces that any food may be sold providing no false description be given, that the article is in accordance with purchaser's demand, and that no substance be incorporated so as to render the article injurious to health.

The following are amongst the offences: Section 3 of the 1875 Act: To mix, colour, stain, or powder any article of food with any ingredient or material so as to render the article *injurious to health*. Section 5, to sell any food or drug not of the *nature, substance and quality demanded*. (*No offence is committed if the added matter is not injurious to health, but is required for its production or preparation as an article of commerce, in a state fit for carriage or consumption, etc.*).

'Sale of Food and Drugs Act,' 1899 (62 & 63 Vict. ch. 51):—

Section 1 virtually enacts that if there is imported into the United Kingdom any of the following articles, Margarine, Margarine-cheese, Butter-milk, Cream, Condensed, Separated or Skimmed Milk, or any article of food adulterated or impoverished the importer shall be liable, unless the same articles be imported in packages or receptacles conspicuously marked with a name or description indicating that the article has been so treated.

Further Sections deal with the method of marking packages. An article of food shall be deemed to be adulterated or impoverished if it has been mixed with any other substance, or if any part of it has been abstracted so as, in either case, to affect injuriously its quality, substance or nature, but an article of food shall not be deemed to be adulterated by reason only of the addition of *any preservative* or coloring matter of such nature and in such quantity as not to render the article injurious to health.

Various forms of apparatus are in the market for detecting adulterations of milk, e.g., The **Lactometer Cream Tube** and **Lactoscope**—the last mentioned detects by the optical properties of milk its adulteration with water—or removal of cream.

Milk, Cream and Butter Preservatives.—The most commonly occurring are :—Salt, Sodium Bicarbonate, Boric Acid, Formalin, Hydrogen Peroxide and Glycerin.

Milk Preservatives.

Experiments show that Boric Acid 1 in 2,000 and Formaldehyde 1 in 50,000 preserve milk for 24 hours. Refrigeration and pasteurisation are also efficacious.

Filtration by means of sand has been suggested. This is largely done on the Continent.

Budde Process of Preserving Milk.

Consists in adding 15 Cc. of a 3% Solution of Hydrogen Peroxide to 1 litre of Milk and warming to 51—52° C. for at least three hours. 48° C. is not sufficient and 55° is too high.

'**Mystin**' a preservative used for milk, cream, etc., on analysis was shewn to consist of Sodium Nitrite 9·85%, Formaldehyde 0·30% in Water. Dr. Monier Williams calculates that a quart of milk treated with the preservative in the proportion directed would contain 2 grains of Sodium Nitrite (*i.e.*, the maximum pharmacopœial dose). The presence of the Nitrite "masks" the detection of presence of Formaldehyde in the milk. After heating the acidified milk with a little Urea the presence of Formaldehyde can then be easily detected or distillation with Phosphoric Acid will set free the Formaldehyde.

'**Accoine**' was found to contain Sodium Benzoate 13·97% and Sodium Carbonate 1·94%. A preservative for Margarine was found to consist of Sodium Fluoride. In detecting the presence of Fluorides the value of the Titanium Test is pointed out, which depends upon the bleaching action of Fluoride Compounds upon a Peroxidised Titanium Solution—the orange-yellow colour of which is partially discharged in presence of Fluorine Compounds.—B.M.J. i./12,384,512. L.i./12,446. P.J.i/12,395.

It is held that *preservatives may prevent milk from tasting sour*, whilst at the same time *not inhibiting the growth of many kinds of disease germs*. According to the new order of things, 'sweet' milk purchased in the hot weather will be in reality fresh, and being fresh the chances that it is contaminated with disease bacteria will be greatly reduced.

Public Health (Milk and Cream) Regulations 1912. The Local Government Board issued regulations under the Public Health Acts which came into force June 1st, 1912 which applied to the whole of England and Wales, ***prohibiting the use of preservatives in milk.*** They provide that "*no person shall add, or order or permit any other person to add, any preservative substance to milk intended for sale for human consumption, and that no person shall sell or expose or offer for sale, or have in his possession for the purpose of sale, any milk to which any preservative substance has been added.*"

Cream Preservatives.

Hamill states (C.D. ii./09,473) that "Thickeners" such as *gelatin*, *starch-paste* and *sucrate of lime* have been used for cream. Mixtures of *Boric Acid* and *Borax* mixed in such proportion so as to be neutral have been used as preservatives. *Saccharin* is used to mask incipient sourness. *Sodium Salicylate* and *Benzoate* are also used in the hope of their being overlooked after the *Boric Acid* (which is allowed to the extent of 0·25%) has been detected. *Formalin* is unsuitable, *Sodium Fluoride* is used and is thought dangerous. *Hydrogen Peroxide* is also employed—100 Cc. of 3% to each gallon maintained at 120° F in a closed vessel for 1½ hours, then 1 or 2 drops of 'Catalase' added to decompose excess of peroxide. Dealers in 'Jug Cream' think the *Boric Acid* permitted is insufficient.

According to work in U.S.A. Sodium Benzoate should be the least harmful of all.

Regulations which came into force October 1st, 1912, provided that the addition of *Boric Acid*, *Borax* or a mixture of these, or of *Hydrogen Peroxide* were *not prohibited in cream containing 35%*

or over of milk fat (no preservative could be added to milk or cream containing less than 35% fat), but a system of declaration was required to be followed by all dealers, *i.e.*, (i.) This cream had to be sold as Preserved Cream, not as "cream." (ii.) The vessel in which it is sold must bear a declaration of the amount and nature of the preservative used.

There was no limit placed on the quantity of any of the three preservatives permitted, and in consequence prosecutions resulted owing to divergence in views as between dealers and medical officers.

The L.G.B. Order, April 2, 1917, consequently amended these Regulations. **Not more than 0.4% Boric Acid** may be **added to Cream** and Cream thus preserved is to be sold as **Preserved Cream**. Label to be affixed stating the amount and that it is unsuitable for infants or invalids. In the case of Hydrogen Peroxide it is not necessary to state the quantity.—L. ii./16,761; P.J. i./17, 146.

Detection of Boric Acid in Milk (*will preserve, 1 in 500*).

This, the most frequently employed preservative, is detected by evaporating and incinerating at least 10 Gm. of the milk. Acidify the ash slightly with dilute hydrochloric acid (using Litmus). A strip of turmeric paper is now placed in the capsule, so as to be only partly wetted by the liquid. Evaporate to dryness at 100° C.

If boron compounds are present, the part immersed in the liquid will turn brownish-red (formation of rosocyanin). On moistening with a drop of caustic soda, green and purple colours will be produced. On re-acidifying with hydrochloric acid, the red colour is restored, and is again changed to green and blue with excess of alkali.

The flame test is well-known. Evaporate to dryness, treat the ash with a few drops of strong sulphuric acid, add a little methyl alcohol, and apply a light. The alcohol will burn with green at the edges of the flame (at the moment of ignition more particularly). We have determined Boric Acid 1 in 5,000 with ease by this method using 10 Cc. of the sample. It will show even 1 in 8,000 but with some uncertainty.

Borax and Boric Acid cannot be differentiated as Borax alone without the use of Sulphuric Acid gave the colour even though the ash of the milk alone was alkaline to Phenolphthalein. If Boron is found titration of the Ash would be the only means of concluding in which form it existed by comparing with an average milk residue Boron free.

Toxic Symptoms.—Gas in the stomach and intestines, colic, pain in the epigastrium and diarrhoea may be caused by excessive consumption of Boric Acid. Possible cause of increase of appendicitis.—Campbell Williams.

Detection of Formalin in Milk.

A teaspoonful will preserve 10 gallons of Milk for 3 days in hot weather.—Pharm. Form.

A large addition can be detected by simply warming; but it is better to distil the milk: the distillate has the odour of formaldehyde, but the preservative is not wholly volatilised even when evaporated to dryness at 100° C. In employing colour tests for formaldehyde a notably weaker reaction is obtained when milk containing formalin is distilled and the distillate tested than when water containing the same proportion of formalin is similarly treated.

O. Hehner determined the rate of disappearance of formalin when added to milk. He found that after one week no formalin could be detected in a sample which originally contained 1 part of formalin in 100,000 parts of milk; after two weeks none could be found in the 1 : 50,000 sample; while after three weeks there was only the faintest trace to be detected in the 1 : 25,000 sample. The experiments were made in cool weather, and the formaldehyde was tested for by Schiff's reagent in the distillate from the milk.

The *best and simplest test* is the **Phloroglucin Test** (*infra*), but Schiff's and Hehner's Tests are used.

Schiff's Reagent.—Mix 40 Cc. of a 0.5% solution of magenta with 250 Cc. of water, add 10 Cc. of sodium bisulphite solution Sp. Gr. 1.375, and then 10 Cc.

of pure strong sulphuric acid; allow to stand for some time, when it will become colourless. It may also be prepared when required for use by adding sufficient of a solution of sulphurous acid to decolorise some of the magenta solution. If the sulphurous acid is added in large excess, traces of formaldehyde will not be indicated. Reddish violet colour proves presence of formalin. *Other aldehydes, including aromatic aldehydes, also give the reaction; but these would hardly be suspected.*

*It is better to distil as above mentioned or to use **Hehner's Test**, i.e., purplish violet ring on layering milk on to strong sulphuric acid; but this is also a group reagent for various aldehyde bodies.*

The presence of Formalin 1 part in 200,000 can be detected with this Test also by the following modification:—

If to the distillate from a sample of milk one drop of a dilute aqueous solution of Phenol is added and the mixture poured upon some strong Sulphuric Acid in a test tube, a bright crimson ring appears.

Phloroglucin Test.—To 5 or 10 Cc. of the milk add 5 drops of 1% aqueous phloroglucin solution; shake and add 5 drops Liquor Sodæ 30%. Salmon colour (not yellowish tint) indicates addition of formalin. *We found that this test will show 1 of Formaldehyde (actual) in 50,000 of milk.*

Rimini's Test.—A satisfactory confirmatory test, being almost specific for Formaldehyde. For method of applying see 'Formaldehyde in urine' p. 397. *We found this test will show 1 of Formaldehyde (actual) in 100,000 of milk.*

Formaldehyde added to foods tends to derange metabolism. Wiley in United States investigated the effects of doses of 100-200 milligrams of Formaldehyde (given with milk) on 12 men during 15 days, the total being 2.5 Gm. to each man. Burning in throat, itching rash, retardation of Nitrogen and Sulphur metabolism, acceleration of phosphorus metabolism, and loss in bodyweight were observed. Apart from harmfulness as a milk preservative, its use is inadvisable, as in dilute solution it prevents the growth of acid forming bacteria, while not retarding many harmful organisms.

Test for Stale, Sour or otherwise Bad Milk.

It is known that the addition of Hydrogen Peroxide to fresh, pure clean milk produces slight evolution of Oxygen, while in the case of stale, sour milk, or milk containing pus or blood or from animals suffering from inflamed udders, fevers, etc., the test produces a much larger quantity of Oxygen and that more rapidly (*c.f.* C.D. Nov. 13/14, p. 34, and Nov. 20/15).

Our experiments (Nov. 1920) show as follows:—

(1) With new milk no gas evolution in the first $\frac{1}{2}$ hour. During the next two hours about 0.5 Cc. evolved.

(2) With sour milk (about 2 days sour) gas evolved at once. After 5 minutes 1 Cc. of gas, after 30 minutes 5 Cc. In the next two hours a further 1 Cc.

(The results were obtained using 50 Cc. of milk in a Doremus tube.)

Ortho-Methyl Amino-Phenol Sulphate, or ***Ortol** (which is a mixture of this body with Quinol and is used in photography) has been used for milk testing. One Cc. 1% solution is added to 10 Cc. of milk and followed by 1 drop of ordinary '10 volume' Hydrogen Peroxide. Raw milk, or milk that has not been heated above 75° C., gives a reddish pink colour.

BACTERIOLOGICAL EXAMINATION OF MILK FOR SUSPECTED SEWAGE OR FÆCAL CONTAMINATION.

Proceed on the lines of a water examination and draw conclusions from the isolation of *B. Coli*. It must be remembered, however, that even the purest milk may show chance contamination of this description. A milk collected with the most stringent precautions in dealing with cows, stables, etc., might possibly show no *B. Coli* at all per Cc. The presence of a considerable number of *B. Coli*, for example 100 per Cc. with the simultaneous presence of *Streptococci* would be grave cause for suspicion of faecal contamination, *e.g.*, in the stables. Again, the presence of *B. Coli* may indicate a diseased udder, for example, mastitis, on the other hand the presence of *B. Coli* would in all probability not be caused by the animals drinking *B. Coli*-infected water.

The **organisms found in milk** may be classed as follows:—(i.) Acid producing (100 varieties), the principal member of which is *B. acidi lactici*; (iii.) *B. acidi butyrici* (has very resistant spores, not killed by pasteurisation);

(iii.) those responsible for fermentation to alcohol, as koumiss, butter milk, red milk, blue milk, &c. (iv.) the mould *Oidium albicans* produces thrush in infants' mouths; (v.) *B. tuberculosis* (a large percentage of cows are tuberculous); (vi.) *Streptococci* associated with contagious mammitis; (vii.) *B. diphtheriæ*; (viii.) *B. coli communis* and *B. typhosus*.

With specially conducted milking, etc., the bacterial content only rose above the 10,000 limit on three occasions. The subject of T. B. in the faeces of apparently healthy cows discussed.—B.M.J. i./20,365.

See also **B. Tuberculosis**.

Cellular Elements present in milk are best stained by May-Grunwalds' Stain. Sodium Chloride of either 0·7, 0·8 or 0·9% not suitable for washing the cells deposited by centrifuge. Washing with Ox Serum gave better results causing the least contraction of the cells of any of the wash liquors tried.—Prof. Hewlett, L. i./15,855.

MAY GRUNWALD'S SOLUTION is a Methylene Blue.—Eosin Mixture similar to Jenner's Stain for typhoid diagnosis.—B.M.J. ii./06,1848; B.M.J.E. ii./96, 77.

Normal milk contains polynuclear and polymorphonuclear leucocytes, which may be mistaken for pus cells, as many as 54,300,000 per Cc. have been observed in an apparently normal sample. It is concluded that mere cell counts do not afford a true criterion of pathological condition of the udder; on the other hand a paucity of cells might also indicate a pathological process.—M.P.C. i./14,457.

"THE NATIONAL LEAGUE FOR PHYSICAL EDUCATION AND IMPROVEMENT" issues leaflets to instil into the minds of all concerned in production and consumption of Milk simple rules required to ensure purity and cleanliness of milk.—L. i./11,123.

"Turning" of milk during thunderstorms accounted for by the usually prevalent high temperature and moisture content of the air favourable to bacterial growth rather than by electrical disturbance.—P.J. ii./12,345.

Condensed Milk should have a minimum of 32% of total milk solids with 10% of fatty solids.

BUTTER ANALYSIS.

Average Chemical Composition of Unadulterated Butters:

Water 6·5 to 11·2, Curd 2·4 to 3·1, Salt 1·6 to 2·0, Fat 83·7 to 89·5%

The following data are necessary to determine quality of a specimen.

- (i) **Estimation of Water**:—Heat 5 Gm. in an air-oven to 110° C. The loss should not exceed 16%, if more suspect careless making or intentional adulteration.
- (ii) **Estimation of Curd and Salt**:—Melt the residue of (i.) and treat with 10 Cc. ether, filter through tared filter, repeat the process and wash until all ether-soluble matter is removed, dry residue and weigh; the residue consists of curd and salt.
- (iii) **Estimation of Ash**:—Ignite residue from (ii.) and weigh. Should be wholly salt; confirm this by standard Silver Nitrate solution.
- (iv) **Estimation of Fat**:—Should be taken by difference by subtracting the sum of percentages of water, cured and salt from 100.
- (v) **Detection of Foreign Fats**:—Prepare some butter-fat by melting 8 Gm., pour off and filter through dry filter, being careful not to pour any of the water on to same. Saponify on a water-bath 5 Gm. of the clarified fat in a tared flask, capacity about 250 Cc. marked at 150 Cc.; add 50 Cc. Alcoholic Solution of Potash (3%) and distil off the alcohol. Dissolve the residual soap in a little hot water, add 25 Cc. Sulphuric Acid (5%) and make up with distilled water to 150 Cc., add a little pumice and capillary glass tubes and distil off 100 Cc., filter same and titrate with N/10 NaOH (using Phenolphthalein). 5 Gm. pure butter-fat should require not less than 25 Cc. of alkali: lard, tallow, beef-fat, &c., require only about 1·5 Cc. coconut fat would require about 7 Cc.

Exception.

In the winter some butters require only about 21 Cc. of alkali, the sample should therefore not be condemned unless it requires less than the minimum amount.

Polenske No. (Zeitsch Nahr. Genussm. 1904, 273). Polenske adopts the Reichert-Wollny process and estimates in the same operation the soluble and insoluble volatile acids. 5 Gm. of the fat are weighed into a 300 Cc. flask and saponified with 2 Cc. Soda solution and 20 Gm. Glycerin by heating.

The flask is cooled below 100° C. and 90 Cc. of hot water and a little powdered pumice are added. When the soap is in solution the fatty acids are liberated with 50 Cc. of H₂SO₄ (50 Gm. in a litre). The flask is then attached to a condenser and distilled so that 110 Cc. of distillate are collected in about 20 minutes. Heating is then stopped. The receiving flask is then removed and a measuring jar is used to collect the drainings of the condenser. The distillate is cooled to 15° C. and shaken and 100 Cc. are filtered off and titrated with N/10 Soda. The number of Cc. (multiplied by 1.1 and corrected to 5 Gm.) is the Reichert-Wollny number.

The remainder of the distillate is poured on the filter paper and then washed with three quantities of 15 Cc. each of water, each of which has been passed through the condenser, measuring jar, and 110 Cc. flask. These washings are rejected. The 110 Cc. flask is then placed under the filter funnel, and the water insoluble acids are dissolved by passing three quantities 15 Cc. each of Neutral Alcohol through the condenser, measuring jar and filter paper. The alcoholic filtrates are titrated with N/10 Soda, using Phenolphthalein as indicator. The number of Cc. required is the insoluble volatile acid number.

In butter fat this number varies with the soluble acids numbers. Polenske (l.c.) gave a range of 1.35 insoluble for 20 soluble, to 3.0 insoluble for 30 soluble. Individual butters may, however, give numbers outside this range. Rideal and Harrison (Analyst 1906, 31, 254) give results of examinations of a number of English butters. Harrison (*ibid.* 1906, 31, 353) showed the variation in insoluble acids number for the same soluble acids number.

Hesse (Chem. Zentr. 1905, 1, 566) says the limits given by Polenske should be higher.—Thorpe, Vol. I., p. 580.

Without this it is stated it would be easy to pass a butter as genuine which contained a considerable quantity of *margarine*.

MARGARINE.

Materials used include Beef Fat, Lard, Cotton Seed Oil, Cotton Seed Stearin, Arachis Oil, Olive, Cocoanut, Palm Kernel, Maize and Sunflower Oil. Fats used here are chiefly the vegetable Cocoanut and Palm Kernel Oil. The Reichert-Meissl or Reichert-Wollny numbers give the relative proportion of the lower members of the series of fatty acids. Cocoanut and Palm Kernel contain a bigger proportion than most vegetable fats of the esters of these fatty acids. The R.M. number for butter is 25 to 30, and any butter giving a figure below is suspicious—B.M.J. i./15.855. In support of Margarine: Hygienic Manufacture.—B.M.J. i./15,1032.

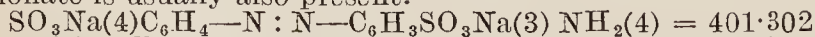
Digitonin has been used in margarine manufacture, for separating the cholesterol and the phytosterol from Oils and Fats in the form of acetates

Vegetable oils to the extent of 40 to 90% of the total fat were found in 15 samples—in most cases it was Cocoanut Oil. The food value of all animal and vegetable fat is the same—both yield 9.1 Calories of energy per Gm.—B.M.J. ii./11,959,1336.

Aniline Dyes used in Colouring Foods.

Egg Yellow.—*Syn.* **Acid Yellow.**

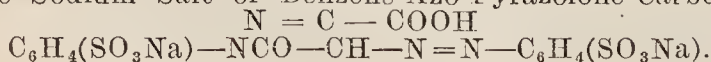
The Sodium Salt of Amido-Azo-Benzene-di-Sulphonic Acid. Some Mono-Sulphonate is usually also present.



A reddish-yellow powder *soluble* in water—aqueous solution has a neutral action, mineral acids change the colour to a bright red, yellow being restored by the addition of alkali. Used for colouring milk (1 in 200,000), Egg Powders—Custard prepared for table contains about 1 in 40,000.

Lemon Yellow.—*Syn.* **Tartrazine.**

The Sodium Salt of Benzene-Azo-Pyrazolone-Carboxy-Disulphonic Acid



A yellow powder, *soluble* in water, almost unaffected in colour by Acids or Alkalies. When Tartrazine is reduced Sulphanilic Acid is formed. Used for colouring lemonade and similar beverages, a common proportion being 1 in 500,000.

Annatto Substitute.

Is a mixture of Acid Brown No. 1 (10 parts) and Acid Yellow (8 parts). *Acid Brown* is the Sodium Salt of Para-Sulpho-Benzene-Azo-Metatolylene-Diamine (4) $(\text{SO}_3\text{Na})\text{C}_6\text{H}_4\text{N}:\text{NC}_6\text{H}_2(\text{CH}_3)(\text{NH}_2)_2(1.5.2.4.)$.

A dark brown powder with occasional yellow specks dissolving easily in water. The solution has a neutral reaction and is of a dark red colour, becoming yellow when greatly diluted. Mineral Acids change the solution to a bright red. Alkalies return original colour.

Used for the same purposes as the vegetable colour (has approximately 25 times the tinctorial power of the commercial extracts of the fruit, of which 1 tablespoonful is added to 30 lbs. cheese, *i.e.*, 1 part in 960) for tinting Milk, Butter, Cheese, (1 in 24,000), Haddocks, etc.

Bixæ Foïia, Ph. Ned. (*Bixacaceæ*). The leaves of *B. Orellana*. Annatto is obtained from the seeds.

Annatto Extract.—Bixin related to *m*-xylene is the essential colouring matter. The Extract is usually strongly alkaline.

General conclusions of the investigation appear to indicate that in the amount used Egg Yellow, Lemon Yellow, and Annatto Substitute are harmless.—S. Rideal, L. i./11, 1597, 1656.

ANNATTO.—A sample (rejected) gave 72.6% matter insoluble in boiling alcohol and contained 18.15% moisture. Another gave 8.5% insoluble.—Evans.

CARBON MONOXIDE AND DIOXIDE TESTS.

Frequent deaths have recently occurred from Carbon Monoxide poisoning. Ordinary Coal Gas and Carbon Dioxide are also sources of danger.

WATER GAS and PRODUCER GAS are used for motive power of engines and for heating purposes, whereas for general lighting **CARBURETTED GAS** alone or Carburetted Water Gas mixed with Coal Gas is used.

PRODUCER GAS is made by passing air or a mixture of air and Steam through Incandescent Coke or Anthracite Coal in a furnace generator, as in the Dowson producer. Consists of Hydrogen, Nitrogen, Marsh Gas, and CO with CO₂ as its principal impurity.

WATER GAS is made similarly, except that steam only is passed through the Coke, and the product being chiefly Carbon Monoxide and Hydrogen, $\text{C} + \text{H}_2\text{O} = \text{CO} + \text{H}_2$.

CARBURETTED GAS differs from both the above. It is made by passing water Gas made as above over heated refractory material charged with oils rich in hydrocarbons. The volatilised benzene and benzene congeners mix with the Water Gas.

Coal Gas contains	6-9%	CO.
Producer or Water Gas	25-50%	,,
Carburetted Gas	30%	,,

The following test will indicate one part of Carbon Monoxide in 10,000 parts of the atmosphere. Even $\frac{1}{4}$ to $\frac{1}{2}$ % of the gas is most injurious, and if inhaled for some time may be fatal (Schmidt).

10 to 20 litres of air are aspirated for about 15 or 20 minutes through 10 Cc. blood (fresh) diluted, 1 to 10 with water. The blood is then heated to the boiling point in a flask, and a current of air is passed into it which has previously passed through a solution of Palladium Chloride.* The air, which passes out of the blood, is then led into bottles containing Lead Acetate Solution, diluted Sulphuric Acid, and another quantity of diluted Palladium Chloride Solution, in this order.

The presence of Carbon Monoxide in the air under examination is proved by the deposition of reduced Palladium metal in the last mentioned Palladium Chloride solution. A quantitative method on this principle is based on the fact that 106 parts of Palladium deposited are equal to 28 parts of Carbon Monoxide.

* Palladium Chloride in 3% aqueous solution *Dose.*—5 to 10 minims before meals. (Has been advocated for use in treatment of tuberculosis of the lungs. Said to improve appetite, and diminish the fever and coughing Contra-indicated in nervous and neurasthenic patients)

Note.—The blood used for the absorption of the Carbon Monoxide, is to be heated immediately after the aspiration with the air under examination and the passing of the air is to be continued three or four hours.

The gas may also be detected by the aid of the spectroscope.

Detection of Carbon Monoxide in the Blood.

In addition to the spectroscopic method, **Kimkel's Colour Test** is valuable.

Necessary are a pipette, 2 small test tubes, and a 3% Tannin Solution.—For details of method see Dix and Mann's Forensic Medicine.

Carbon Dioxide.—Haldane's apparatus is used for estimation in the air

Nickel Carbonyl has caused degeneration of certain parts of the nervous system and produced death. Symptomatic treatment and purgation cured a case of nickel poisoning in a metal worker caused by nickel dust being absorbed.

The poisonous symptoms are occasioned by the absorption of the nickel set free. The nickel is deposited over the surface of the lungs in a condition especially favourable for its absorption, probably as a hydrated sub-carbonate.

Antidote.—Oxygen.

For treatment of persons who have inhaled the noxious gases provide fresh air, sulphur baths, good food with quinine and Nux Vomica, Chloroform Liniment with friction for local neuralgia and commencing neuritis.

Chlorine inhalation and taken internally has been employed. Early and judicious use of this (by action of Hydrochloric Acid on Potassium Chlorate) should be successful.

Interesting Experiments at the London Hospital (June, 1910), on 6 students showed that Carbon Dioxide (4%) is not poisonous but injurious effects due to stagnant condition of the air and moisture.—*Fanning* the air caused resuscitation.

Carbon Monoxide poisoning in the Senghenydd explosion.—B.M.J. ii./14,57

CARBON MONOXIDE POISONING in warfare and in blasting—useful chemical and medical notes.—W. J. Rutherford, L. i./20,184.

GAS POISONING.

Phosgene, Chlorine, Dichlorethylsulphide, and the tear gas Xylol Bromide — effects.—Sir W. P. Herringham, L. i./20,423,437. (See also Vol. I., p. 1022.)

Dichlorethyl-Sulphide. Absorbent powders such as Cocoa-nut Charcoal, Fullers Earth, Talc, etc., found efficacious.—T. Sollman. JI. Pharm. & Exp. Therap., January, 1919.

Dichlor-ethyl Sulphone is of the same order of activity as Dichlor-ethyl Sulphide, while Dichlor-ethyl Sulfoxide is practically inert.—E. K. Marshall, Jr., and J. W. Williams, JI. Pharma. and Exp. Therap., Nov., 1920.

Ethoxydichloroarsine and allied bodies, observations on (for war purposes).—A. McKenzie and J. K. Wood, J.C.S. Apl. 20, 406.

Diphenylchlorarsine and Diphenylcyano-arsine.—G. T. Morgan & D. C. Vining, J.C.S., June 20, 777.

The above are references on the subject additional to information in Vol. I. pages 1022 and 1023.

PTOMAINES.

Under this name are classed a number of basic substances which are produced in meat, fish, and albuminoid food undergoing putrefaction by decomposition or by bacterial metabolism. They are akin to the alkaloids, several being dangerous poisons. Hence the occasional outbreaks of ptomaine poisoning from the consumption of meat pies, fish and the like.

Symptoms are those of gastro-intestinal irritants, but they may resemble those of Atropine poisoning. Dryness of the tongue, thirst, dilated pupils, debility, with probably rigors, offensive diarrhœa, high temperature, sickness with convulsions.

Tyrotaxon occurs in stale cream, cheese, milk products; causes vomiting, purging, rapid pulse, dyspnoea, depressed temperature and prostration.

Antidotes.—Give emetics and Castor Oil, then stimulants. Amyl Nitrite, Strychnine, Digitalis, Caffeine, Sal Volatile, Tannic Acid, and Atropine hypodermically

For **Fish poisoning** give Potassium Chlorate or Liquor Ammoniaë Acetatis, also Tinctura Capsici and Spiritus Chloroformi.

Presumed Ptomaine poisoning from tinned fish.—L. ii./03,755,848.

Poisoning by bad bacon treated with Calomel, and later injections of Atropine and Strychnine.—B.M.J. i./06,258.

Outbreak of illness due to tinned meat in Carlisle. The meat (American Corned Beef) reported as bacteriologically unfit for food. It was proved to be contaminated previous to, or at the time of, canning in America.—L. ii./10,1613.

EXAMINATION OF STOMACH CONTENTS.

An extended series of examinations proves that in a healthy subject *food commences to pass the pylorus in from fifteen minutes to half an hour after ingestion*, the time varying with the character of the food (*e.g.*, carbohydrates leave the stomach before proteins), and the stomach is empty in five hours. *The passage through the small intestine takes about three and a half to five hours about one inch a minute, so that there is food in the cæcum before the whole meal has left the stomach.*—H. W. Carson, Oct., Pr., 1912.

An **Outfit** is arranged containing the necessary **Reagents and Apparatus**. The **Reagents** include Blue Litmus Paper, Congo Red (an aniline colour turned blue by acids and red by alkali, the reverse of Litmus, indicates absence of Hydrochloric Acid in the stomach in cases of cancer, as weak Lactic Acid does not interfere), Benzopurpurin Paper, Alizarin Solution, Dimethyl-amido-azo-benzol Paper and Solution (an acid and alkali indicator which is not affected by Carbon Dioxide—a 1 in 500 Alcoholic Solution of the compound is used in ordinary chemical testing), Decinormal Soda Solution, Ether, Caustic Potash Solution, Phenolphthalein* Solution (1 in Alcohol 90%, 300 with Distilled Water to 500, is reddened by alkali, but is not suitable for ammonia estimation), Cupric Sulphate Solution, Lugol's Solution, Methyl Green and Methyl Violet and other Test Solutions.

The **Stomach Tube** should have bevel-edged eyes, known as "velvet eye." Van Valsh's tube has the smaller eye of the two which should be on a level with and opposite the upper border of the other: this arrangement prevents possible blocking of the tube and injuring the lining of the stomach.

Aseptic Lubricant Glycerin Jelly, is used for assisting the passage of these tubes. A Glyco gelatin Pastil of Menthol, gr. $\frac{1}{2}$, with Cocaine Hydrochloride $\frac{1}{2}$ grain, is also useful to be sucked just before passing.

Inflation of the stomach for diagnostic purposes is best carried out by the double bellows of a spray apparatus attached to a stomach tube.

A method of inflation is by giving first Tartaric Acid, 30 to 90 grains in water, followed immediately by 40 to 120 grains of Sodium Bicarbonate, and another is by Auto-inflation by means of Spivate's tube.

Portions of stomach contents are removed to examine for acidity, to ascertain the presence of food, mucus or gastric secretion, when it should normally be empty; to examine test meals and to search for pus, blood and bacteria

***Phenolphthalein** is employed as an indicator in volumetric analysis as it turns pink with alkalis. It is not suitable for titration of ammonia. It is the best indicator for inorganic and organic acids, remove CO_2 by boiling. Where CO_2 is evolved Methyl Orange (*q.v.*) is better, but this is not satisfactory with organic acids.

Thymolphthalein.—Dissolves in caustic alkalis forming a blue colour. May, therefore, be used as an indicator—is not affected by excess. To prepare heat Thymol 3, Zinc Chloride 2.5 and Phthalic Anhydride 3, for 6 hours at 115 to 120° C. Break up when cold and remove Thymol with Steam. Dissolve in Caustic Soda and pour solution into dilute Hydrochloric Acid, wash precipitate with water and crystallise from Alcohol.—P.J. ii./13,881.

The use of **Thymolsulphonaphthalein** has many advantages as an **Indicator in acidimetry** owing to the fact that it shows two distinct changes of colour at different hydrion concentrations. It may be used for the differential titration of mixtures of weak and strong acids, *e.g.*, Benzoic and Hydrochloric, or Acetic and Sulphuric, although in the last the error may be as much as + or - 0.5%. It can be used to titrate Aniline with Hydrochloric Acid.—Abst. Ann. Rep. Chem. Soc., 1919 (Vol. XV.), p. 132).

Dunham's Tassel consists of a little tassel of thread soaked in Dimethyl-amido-azobenzol Solution. It is attached to a thread, the patient swallows it, it is removed, after an interval, and the resulting colour gives the condition of the stomach as regards free Hydrochloric Acid.

Turck's Capsule consists of a hard Gelatin Capsule, No. 00, enclosing a small rubber tube attached to a thread for withdrawing, and provided with strips of Congo Red, Blue Litmus and Dimethyl-amido-azobenzol papers; after swallowing and withdrawing, the resulting colours will be:—

1. If stomach contents neutral, no change in colour of any of the Papers
2. If no free acid, but only combined acid and acid salts, the Litmus will be red and the others unaltered.
3. If there be free organic acid but no free Hydrochloric Acid, the Congo Red will be blackish blue, but the Dimethyl-amido-azobenzol Paper will be unchanged.
4. If free Hydrochloric Acid present, all the Papers will be changed—the Litmus red, the Congo Red blue, and the Dimethyl-amido-azobenzol Paper will be red.
5. If both Hydrochloric and Lactic Acid be present, the Congo Red Paper will have a blackish tinge.

The rubber tube will contain sufficient material for microscopic examination, *e.g.*, for the Oppler Boas Bacillus or Sarcinæ.

By means of a **Silver Stomach Bucket** a small quantity, *i.e.*, about 2 Cc. may be lifted up out of the stomach and examined. By **Turck's Aspirator Bottle**, which is exhausted by means of a bulb, the stomach contents flow into the bottle. This is one of the simplest methods of removing stomach contents.

The **Water Test** for myasthenia consists in introducing into the stomach 300 Cc. of water first thing in the morning, fasting, and $1\frac{1}{2}$ hours afterwards another 100 Cc. containing 1% of glucose. In due course a small quantity of the stomach contents are removed and the sugar estimated (p. 399, *et seq.*), from which is determined the amount of the original 300 Cc. remaining in the stomach.

Ewald's Test Breakfast consists of two or three ounces of dry bread and 10 ounces of hot water, or weak tea without milk or sugar. The Lactic Acid in bread vitiates the results where the presence of this acid is of importance, as in the early stages of cancer.

Boas's Test Breakfast (given after lavage) consists of one full tablespoonful of oatmeal to a quart of water, reduced to a pint by boiling. There are a variety of other tests (meat and bread) meals.

The following are abstracts from the works of Willcox, Herschell, Martin and others:—

Chemical Examination of the gastric contents after a test meal, containing little protein and nitrogenous bases.—Willcox, L. ii./o8,220:—

The Hydrochloric Acid in this case will be present as far as possible in the free condition (which is the point of importance in diagnosis of gastric ulcer).

I. Total Acidity (Normally = 0.15% HCl). Determine whether there is active Hydrochloric Acid or a mixture of this and organic acid. Usually in chronic gastritis acidity is low. In *gastric ulcer it is high*. In *carcinoma it is usually low*. (A normal acidity does not exclude gastric carcinoma.)

It is increased in simple hyperchlorhydria, peptic ulcer, cholelithiasis, appendicitis, and colitis.—L. i./13,462.

Increase in the mineral Chlorides may be an earlier sign of carcinoma than the diminution of the active acid. The condition may be accounted for by the secretion of an alkaline fluid in the stomach—probably by a malignant growth that has begun to ulcerate.—Q. Jl. Med., Apl., 1911,334.

Without doubt both total acidity and free Hydrochloric Acid are raised in a considerable proportion of ulcer cases. Duodenal cases show on an average a larger and more constant increase of acidity than the ulcers on the gastric side. Discussion on gastric ulcer.—B.M.J. ii./12,940, *et seq.*

Litmus Paper is affected by Hydrochloric, Lactic and Butyric Acids.

Congo Red Paper.—As already stated—the colour caused by organic acids will disappear on warming over spirit lamp whilst that due to Hydrochloric acid remains.

II. Hydrochloric Acid. This, according to Willcox, is either (a) **free**, (b) **combined** with protein and organic bases (*i.e.*, **physiologically active**), or (c) **Inorganically combined** (*i.e.*, **physiologically inactive**). Normally free HCl is 0.1%.—B.M.J. ii./12,940.

(a) **Phloroglucin test for free Hydrochloric Acid (Gunzburg):**—

Phloroglucin 2 Gm., Vanillin 1 Gm., Alcohol 90% 30 Gm. A rose red colour formed on warming a few drops with an equal amount of the specimen in a porcelain dish indicates presence of the Acid. May also be best kept in powder form—2 parts of Phloroglucin and 1 part of Vanillin. As much as will lie on the point of a penknife, added to a few drops of alcohol, forms a perfectly reliable solution. This is the most trustworthy.

This test is positive with free mineral acids and may be relied on to show the absence of Free Hydrochloric Acid.—L. ii./12,1104.

Resorcin will do instead of Phloroglucin—a few crystals of this and of Vanillin dissolved in a drop of the test meal and evaporated to dryness give a clear result.—Slightly more purple than with Phloroglucin. The result is positive with very dilute Hydrochloric Acid in protein solution, and negative with combined Hydrochloric Acid and with Lactic Acid.—P. N. Pantou, L. ii./18,125.

Response to **Dimethylamidoazobenzol** may be given by organic acids if these are present in large amount. The latter may be used first, followed by Gunzburg's test as confirmatory. If the test meal has been such as to give the Hydrochloric Acid the opportunity of being present in the free condition, then in normal gastric contents it will usually be present.

In *gastric ulcer* and *hyperchlorhydria* always present; in *carcinoma* scarcely ever present.

(**Lignified Tissue** moistened with a little Hydrochloric Acid, then a little Phloroglucin applied, gives the well-known crimson colour. The author has found that **RESORCIN** moistened with Hydrochloric Acid gives a purple colour with pine wood (also with oak and teak, but not so rapidly), and with newspaper made from wood pulp, but Resorcin gives no colour with linen papers.)

Boas' Test for Free Hydrochloric Acid.—Resorcin 5, Cane Sugar 3, Alcohol 100. This test is used exactly as Gunzburg's test, the same red color being produced, but Boas' requires heating more carefully, as it chars more readily and the color is not permanent.

(b) **Physiologically Active Hydrochloric Acid, *i.e.*, Free and combined** with protein and organic bases (normally about 0.15%)

Willcox's Modified Volhard Method.

Two equal quantities of gastric contents are taken, one rendered alkaline with soda,—both are evaporated and ignited. In one case the *Total* Hydrochloric Acid, and in the other the Hydrochloric Acid combined with inorganic bases only is obtained. Difference gives *Active* HCl. In gastric ulcer and hyperchlorhydria the Active HCl is equal to or nearly equal to the total acidity, and is usually over 0.15%. In gastric carcinoma the Active HCl, as found by Willcox, is nearly always much reduced,—always under 0.1%. In chronic gastritis the Active HCl is often below normal.

Differential Estimation of Physiologically Combined and the Free Acid

The fluid is titrated with Alkali in presence of Dimethyl-amidoazobenzol as indicator, the result being the physiologically combined + Free Hydrochloric Acid; then another portion is titrated with Alizarin Red (1% Aqueous Solution) as indicator, which gives Free Hydrochloric Acid only. The amount of alkali required in first titration minus the amount required for the second titration is the amount required by the *Physiologically Combined Hydrochloric Acid, i.e.*, Hydrochloric Acid combined with proteins and other weak bases, *e.g.*,

1st titration showed 0.2% calculated as Hydrochloric Acid.

2nd titration showed 0.15% Free Hydrochloric Acid.

0.2—0.15 = 0.05% Physiologically Combined Hydrochloric Acid.

Gastric Contents, Acidity Estimation.—H. L. Tidy, L. ii./12,1104. Reply upholding the accuracy of Volhard's method by G. Graham and R. L. Mackenzie Wallis *ibid* 1460.

III. Organic Acid, Lactic Acid. According to Willcox *great* importance should not be attached to presence or absence of this acid. Organic Acids in considerable amount are present in carcinoma of the stomach and where much fermentation is going on. By others, again, the presence of Lactic Acid is considered of grave importance, especially if in considerable quantity, *v. infra*.

Lactic Acid is not present in the normal stomach. If found is suggestive of carcinoma.—H. W. Carson, Pr., Oct., 1912.

Uffelman's Test for Lactic Acid—(not entirely satisfactory). Ferric Chloride Solution 1 drop, Phenol 0.4 Gm., water to 50 Cc. (Delicacy limit 1 : 10,000—the violet colour changes to yellow.)

An approximate estimation may be conducted as follows:—

Distil off 30 Cc. from 40 Cc. of the filtered stomach contents the total acidity of which is known. The volatile acids go over; the residue contains the Lactic and Hydrochloric Acids. The acidity of the distillate (found by titration with $N/_{10}$ Soda, using Phenolphthalein as indicator) deducted from the total acidity "A" (found by titrating 10 Cc. of the filtered stomach contents in the same manner, the result being expressed in terms of Hydrochloric Acid) gives the amount of Lactic and Hydrochloric Acids together. If the amount of HCl "H" (found in the same way as "A," but using Dimethyl-amido-azobenzol as indicator) be deducted from this, the remainder is Lactic Acid.

IV. Mucin. Important. In gastric ulcer and hyperchlorhydria usually absent. In gastric carcinoma a definite precipitate occurs on adding 2% Acetic Acid. In simple gastritis often present in small amount.—Willcox. It is soluble in Sodium Hydrate Solution. Dried film is deeply stained reddish violet by Thionin Staining Solution.

Mucus normally is stained faintly, but that met with in chronic gastritis deeply with Methyl Green.

Blood is recognised microscopically.

Ferment Activity. Determination of Pepsin and pepsinogen present is of great importance. Willcox has devised a NEW METHOD:—

Action on milk by determination of the activity of the gastric juice by **Rennin** contained (usually proportionate to Pepsin) by using a series of tubes containing 5 Cc. of milk, to which are added gradually increased quantities of the gastric juice, and the mixtures maintained at 40° C. for 30 minutes. About 0.2 Cc. of normal gastric juice (of the adult) is required in this test.

In *gastric carcinoma* much more.

In *gastric ulcer* and hyperchlorhydria usually less (0.05 or less)

In certain cases it may be necessary to estimate **Renninogen**,—consult the paper.

Rennin is tested for by adding a few drops of the filtered and neutralised stomach contents to two or three Cc. of milk and maintaining the mixture at 98° F. for a quarter of an hour, resulting coagulation indicates presence.

For testing for **Rennin Zymogen**, a small quantity of Calcium Chloride is added prior to incubation. A pocket incubator may be used for these experiments.

Tables in which the analytical data had been obtained are provided of cases of:—

- (1) gastric ulcer and hyperchlorhydria, (2) gastric carcinoma, (3) mucous colitis.
- (4) stomach normal, (5) chronic gastritis, (6) gastric ulcer.—L. ii./o8,220.

Digestive activity of the stomach contents (*i.e.*, amount of Pepsin secreted) increases or diminishes with the amount of Hydrochloric Acid secreted by the mucous membrane. A number of cases of gastric carcinoma compared with cases of ulcer and functional disease showed that on the whole the greater proportion of cases evidenced a great diminution of acid secreted, as well as diminution of digestive power.—S. Martin. L. i./o9,398.

Simple methods of Diagnosis in Disease of the Stomach:—

This paper differs in some particulars from the views of the previous writer.

For practical purposes, as all that is required to know is *whether the free Hydrochloric Acid is normal, subnormal, or excessive*, the author has devised a special tube for estimating. To the point "A" on it a filtrate of gastric contents is introduced. A drop of mixed Phenolphthalein and Dimethyl-amidoazobenzol is added, then drop by drop $N/_{10}$ NaOH Solution till the red colour has disappeared. The marks on the tube show whether the amount corresponds to a normal, sub-normal or excessive value for *free HCl*. $N/_{10}$ NaOH is again added till the red colour of the *Phenolphthalein* appears—this gives the *Total Acidity*

When there is free Hydrochloric Acid it is no use testing for Lactic Acid.

When there is normal total acidity lactic acid is rarely present, but when no free Hydrochloric Acid and total acidity is low *Lactic Acid* must be tested

r. Lactic Acid denotes subacidity combined with stasis due either to

pyloric obstruction or fermentation due to an ulcerating growth. These two factors occur together in carcinoma and rarely in other diseases. A well-marked reaction with **Uffelmann's Test** (*q.v.*) must be obtained to be any evidence.—L. i./09,526.

In gastric ulcer, results with test meals indicated in the majority of cases excess of free Hydrochloric Acid.—L. i./09,764.

Contrary to Prof. Moore, Copeman and Hake find the physiologically active Hydrochloric Acid in mice and rats with transplanted or spontaneous tumors, is not only not diminished, but for the most part is in slight excess above the normal.—L. i./09,755.

The diminution of the gastric Hydrochloric Acid is general in cancer, not only of the stomach, of any origin.—Hewlett, P.J. i./13,248.

The **Oleic Acid Method** of diagnosing gastric malignant disease, *v.p.* 473.

HYPERCHLORHYDRIA AND ITS COMPLICATIONS.—W. Russell was the first to clearly differentiate hyperchlorhydria from other gastric ailments. The purpose to which Hydrochloric Acid is applied is in acting with Pepsinogen. It is said that digestion never fails from deficiency in Pepsinogen because of its great power even in small quantity. The symptoms of hyperchlorhydria are burning pain at the cardiac orifice of the stomach, acid eructations, water-brash, usually flatulence and constipation. In some cases there is a sense of dragging or weariness or a hunger discomfort coming on two hours or less after breakfast, and removed by taking a glass of milk, a drink of cold water or soda-water or a cup of tea. Somewhat later in life there is much gastric discomfort or definite pain coming on an hour or two after a meal. This is associated with mental depression and great difficulty, amounting in some cases to complete incapacity, for mental or physical effort. On removing the gastric contents in such cases they are found to be intensely acid and to contain much free hydrochloric acid. That this hyperacid fluid is the cause of the pain and depression is proved by the immediate relief of the symptoms when it is withdrawn. A *simple test* in Scotland for digestive conditions is the following:—If *porridge and milk cause acidity* the digestion is not right. Sodium Bicarbonate not only counteracts the free Hydrochloric Acid, but also inhibits acid secretion. For inhibition of secretion Belladonna is best.—B.M.J. i./10,2014

Some authorities are of opinion that *no such condition* as hyperchlorhydria really exists, and that an ordinary "acid dyspepsia" due to an excessive secretion of normal gastric juice is capable of causing most of the symptoms ascribed somewhat indiscriminately to hyperchlorhydria and duodenal ulcer. This opinion is strengthened by the fact that estimates of free Hydrochloric Acid have proved inconsistent.—B.M.J. ii./11,1528.

The pain of GASTRIC ULCER has been attributed to an excess of Hydrochloric Acid acting on the affected membrane. 0.5% Hydrochloric Acid applied to an abrasion of the skin produces smarting and might be expected to cause pain in a gastric ulcer, but was quite tolerated when 4 ounces were introduced into the empty stomach by a tube where gastric ulcer was subsequently diagnosed by operation. Similarly HEARTBURN has often been ascribed to the regurgitation of the Hydrochloric Acid into the oesophagus, but some observations negatived this also; nevertheless the Acid is in some way evidently connected with the production of the pain, as Alkali relieves it.—L. i./11,1215.

Nitrogen Factor.

The Phenolphthalein and Dimethylamidoazo-benzene readings of acidity are employed to give what is termed the Nitrogen Factor. In an active stomach "*Phenol*" minus "*Dimethyl*" reading is a constant under Normal Test Nitrogen meals, etc. A certain multiple of this constant—the Nitrogen Factor is normally about 2.4. A rise above this indicates stasis or impairment of the digestive process. Table of 19 cases presenting appendicular disturbance.—C. Singer, L. ii./12,1711.

Test for the products of **Starch Digestion**. The presence of Erythro-dextrin in any quantity (giving a brown colour with Lugol's Solution) one hour after a test breakfast will point to hypochlorhydria.

Gunzburg's Capsule, for testing digestive power, consists of $\frac{5}{16}$ inch of thin rubber tubing, $\frac{1}{2}$ inch in diameter, containing $1\frac{1}{2}$ gr. Potassium Iodide plugged with pledgets of Fibrin at each end.

Fermentation is examined by means of an ordinary Doremus Ureometer.

Estimation of the **digestive power** of the gastric juice is effected with hard boiled egg by examining for peptone after two hours or so at 40° C.

Peptic Index.

Edestin, a substance made from Linseed, is purified by recrystallisation from warm salt solution. It is soluble 1 in 60 of 0.2% Hydrochloric Acid, 1 in 25 of 0.5% Sodium Hydrate, about 1 in 460 of 4% Sodium Chloride. Much more soluble in the last mentioned at 65° C.—which constitutes its method of manufacture. The purified preparation is dissolved in the proportion of 0.1 per cent. in 0.12 per cent. HCl. Of this solution 2.5 Ccm. are poured into each of ten test tubes, and allowed to stand at the ordinary temperature of the room; 1 Ccm. of filtered stomach contents is diluted to 10 Ccm. and then 0.1, 0.2, 0.3, and so on, in a gradually increasing series up to 1, of diluted stomach contents are added to the solution in the tubes, which are shaken and allowed to stand for half an hour; at the end of this time 0.3 Ccm. of a saturated solution of common salt are added to each tube and the tubes again shaken; at a certain degree of concentration the solution remains clear, but with less digestion a white precipitate forms.

The following conclusions have been arrived at: (1) That the estimation of the peptic index by the Edestin method affords a useful help in the diagnosis of organic diseases of the stomach and duodenum. (2) That peptic index and the chloride secretion vary ordinarily in the same direction when the wall of the stomach is the seat of organic disease, and where there is an exception to this rule it generally occurs, we note, in the form of a relative lowering of the peptic index. (3) In the early stages of duodenal ulcer the peptic index is *ordinarily high* (over 60) and the secreted chloride also high (over 6); in the experience of the authors this is almost pathognomonic of duodenal or pyloric ulcer. (4) In the advanced and developed cases of duodenal ulcer the peptic index may be low; in very chronic cases the chloride secretion may also fall. (5) Cases of pyloric ulcer follow the same rule as cases of duodenal ulcer, but in the former the peptic index is ordinarily somewhat lower. (6) Gastric ulcers not seated at the pylorus show no definite alteration of the index, but it is ordinarily somewhat low. (7) Cancer of the pylorus generally leads to slight lowering of the peptic index and the chloride secretion, but in the early stages the chloride secretion may even be raised. (8) Cancer of the stomach which has spread to the small curvature from the pylorus causes always marked lowering of the peptic index and nearly always that of the chloride secretion. (9) Chronic appendicitis with gastric symptoms may be accompanied by organic changes in the stomach, but these may also be absent. A definite relative raising of the peptic index over the chloride secretion is met with chiefly in those organic diseases which are combined with appendicitis.—B.M.J. ii./13,885.

Keratin Coated Hard Gelatin Capsules (largest size) filled with **Bismuth Carbonate**, and **Chain Cachets** (2 inches of fine silver chain in a cachet attached to a piece of silk), are used for **X Ray examination** of the stomach. Barium Sulphate and Bismuth are also used, *c.f.* Vol. I., pp. 220, 225, 230.

Microscopic Examination reveals starch, sarcinæ and the **Oppler Boas Bacillus**, present in malignant disease—stained with Methylene Blue. (It is Gram + staining.)

On **gastroscopy**—a plea for its routine employment by gastric experts. Topical applications by means of the method can be made to ulcers, portions of a tumour can be removed for microscopic examination and a pin or needle sticking into the gastric mucosa could be released or retrieved.—William Hill, B.M.J. ii./09,843; B.M.J. ii./11,1074.

Tropæoline OO and **Methyl Orange** (Helianthin), *e.g.*, as Solution—Methyl Orange 0.4, Alcohol (90%) 50, Water to 200, are yellow colours used for testing for the presence of free acids. The former is changed to crimson by acids, the latter to pink, but no change is produced by Carbon Dioxide, Acid Carbonates or Metallic Salts. They are not suitable for Organic Acids. Acid Phosphates, *e.g.*, NaH_2PO_4 are not acid to Methyl Orange.

Rosolic Acid. *Syn.* AURAMIN, AURIN, CORALLIN.

1% in 60% Alcohol. Turns rose red with alkalis and yellow with acid. Remove CO_2 . It is not suitable in presence of NH_3 .

BACTERIOLOGICAL AND CLINICAL NOTES

with reference to Special Diseases.

[A Bacteriological Test Case is arranged containing the Apparatus, Stains and Solutions necessary for taking and examining **Diphtheritic** Scrapings, for detecting the **Gonococcus** in discharge, for staining Sputum for **B. Tuberculosis**, for collecting Blood for **Widal's Typhoid Reaction**, for the **Gram** separation of Organisms, and for all other general clinical diagnoses].

Acne Vulgaris (obtain specimen by puncture and decompression of papule or pustule).—A. Fleming (L. i./09,1035, B.M.J. ii./09,533) described the bacteriology of acne vulgaris. Gram positive organisms which, when seen in pus, are arranged very irregularly. In 44% of the pus films examined only acne bacilli were found. Acne bacilli with *Staphylococcus* were present in 53%. The acne bacillus *Syn. "Bottle Bacillus"* stains less deeply than the cocci. The bacillus grows with difficulty on artificial media. A suitable medium for growing the organism was found to be Nutrient Agar containing 1 to 5% *Oleic Acid*. *Cultivation*.—Good results may be obtained by growing anaerobically in broth 3 weeks and then plating on Serum Agar with Neutral red and about 2% *Oleic Acid*.

It can also be grown in deep tubes of 2% Glucose Agar,—the reaction of the medium being distinctly acid. Whitish colonies after three or four days at 37° C. appear which under a low magnification show a lenticulate shape. The relation of the bacillus to the suppuration in acne has been a matter of dispute.—M. & R.

Sudmerson and Thompson use an acid Serum Agar taking the deeper parts of the comedo in which the bacillus usually predominates, emulsify this in Saline and spread thinly on the slope so as to obtain colonies to pick off.

Cultivation from the comedo :—

T. H. C. Benians recommended for making Vaccines to grow simply in a tube of broth—the comedo being removed to same and then covered with Sterile Oil. *Staphylococcus Albus* will be present but is negligible—the bacilli out-growing these Cocci in about a week. The conditions are thought to resemble those in a sebaceous gland—L. i./13,1801.

For details of **Acne Vaccine** vide *Vol. I.*, p. 843.

Actinomyces.

A parasitic disease, due to the 'ray fungus,' first observed in cattle (wooden-tongue), characterised by chronic inflammation, with or without suppuration, frequently resulting in formation of granulation tumours, especially about the jaws. Vide Potassium Iodide, *Vol. I.*, p. 660, for treatment.

To identify the fungus. 1. Place specimen, pus or sputum, in a flat glass dish on a black surface. Remove the characteristic yellowish particles if found, and carefully tease out on a micro-slide or cover-glass. 2. Fix film over the flame, *s.a.* Stain by the Gram-Eosin method, *v.* p. 556.

The violet stained mycelium of the fungus as tangled webs or scattered filaments will be seen on a pink ground (leucocytes, epithelia, &c.), with a $\frac{1}{8}$ inch or even $\frac{2}{8}$ inch objective.

The "rays" may be observed without staining, but the stained specimens are confirmatory and valuable for reference. N.B.—*They are not found in man—only the filaments.*

Primary ovarian actinomyces, a case of. Only six cases on record. Here the ovary was the primary seat of infection, and hence unique.—L. i./09,758.

Actinomyces vaccine suggested of strength 1 Cc. = 0.0001 Gm. Solid Substance as initial dose rising to 1 Cc. containing 0.001 Gm., repeated according to clinical symptoms.

A case of actinomyces (streptotrichosis) of the lung and liver successfully treated with vaccine.—B.M.J. i./08,554.

Actinomyces, the result of chewing a stalk of corn, treated by Vaccine. Initial dose $7\frac{1}{2}$ millions, subsequently 5 millions—17 inoculations in all. Complete recovery.—J. Collie, B.M.J. i./13,991.

A case of Actinomyces of the lungs.—B.M.J. i./12,302. Local lesions closely resemble tuberculosis.

Curetting with a dry swab as opposed to the use of a sharp instrument found satisfactory. Vaccine in dose of 25 million fragments once a week

for a month. Four injections effected a cure combined with large doses of Potassium Iodide. The above dose of vaccine is larger than usually advised (3 to 10 million).—C. W. Dean, B.M.J. i./17,82.

Actinomycosis of the cæcum. On opening the abdomen a quantity of purulent fluid welled up (*Actinomyces* found). Potassium Iodide 50 grains thrice daily.—E. G. Slesinger, L. i./20,1220.

Ankylostomiasis (see also Vol. I., p. 744).—The worm producing this disease (*Ankylostoma duodenale*) is about $\frac{1}{4}$ inch long and of a whitish colour. Its habitat is the small intestine of man, particularly that of the miner. It attaches itself to the mucous membrane, and no fewer than 1,000 of them have been obtained from one patient. The male and female worm are quite different in formation. The eggs produced by the female pass away from the patient—as many as 8,000,000 have been delivered by a sufferer in a single day—and the small thread worm escapes from the egg. Mines afford an excellent hatching place for the young larvæ. Hygiene and sanitary measures are alone necessary to stamp out the scourge.

It is probably not a blood sucker.—The æmia it produces is probably due to toxins with a hæmolytic action.

Discussion on ankylostomiasis. Anæmia caused is frequently profound, producing ultimate death. Milk diet for a day or two, then Calomel and saline aperient; following morning Thymol 20 to 30 grains in a catchet, repeated twice at 1 hour's interval, with another Saline 2 hours after the last dose.—B.M.J. ii./09,1350.

ANKYLOSTOMIASIS—LIFE HISTORY detailed, Mode of Infection, Duration of Infectivity. There are said to be two causative organisms. Most of the disease in the Southern regions of the U.S. and in Porto Rico was thought to be due to *Ankylostoma* (*Necator*, *Uncinaria*) *Americanum*, as distinct from the generally known *A. duodenale*. *A. Americanum* has not been identified in the Cornish mines. Where both species are abundant, individuals are often doubly infected. Methods of detecting eggs in fæces, v. L. i./11, p. 783. See also B.M.J. ii./09,779.

In goitre Thymol appears to act by destroying the living excitant or by reducing its numbers or activity in such a way that the production of toxic substances is lessened and the thyroid gland is relieved of the excessive demand for its secretion which necessitated hypertrophy.—Maj. R. McCarrison, L. i./13, 369. Ankylostomiasis, Crusade against, in Bengal.—L. i./20,828.

For further details on Thymol Treatment *vide* Vol. I., p. 740, Eucalyptus, Oil, p. 405.

Anthelmintics. *Efficacy as tested on earthworms.* (See also Vol. I. p. 421, 744, 1015.)

MUSTARD OIL is highly toxic (explaining the anthelmintic use of the allied onion and garlic).

COPPER SULPHATE also,—suggests its use in enemas against oxyuris. The toxicity of this chemical is very high, being equalled only by Mercuric Chloride and surpassed by no other drug so far tried.

SANTONIN was found efficient.

Fresh PUMPKIN and "SQUASH" SEED are quite powerful and harmless anthelmintics. The active constituents are soluble in water. They are gradually destroyed by boiling.

THYMOL was also found active as also CHENOPODIUM OIL, Aspidium, and Betanaphthol.

BILEIN with Sodium Bicarbonate was used for insoluble substances. The whole paper is most exhaustive and painstaking.—T. Sollman, Jl. Pharm. & Exp. Therap., Oct. 1918.

CARVACROL. Experiments with as anthelmintic. Administration must be worked out carefully.—T. Sollman, Jl. Pharm. & Exp. Therap., Nov. 1919.

PARADIBROMBENZENE AND *p*-DICHLORBENZENE are suggested as anthelmintics. Absorption probably slight. Non-toxic.—Jl. Pharm. & Exp. Therap., Nov. 1919.

Anthrax (for Antitoxin, see Vol. I. p.844).—*Bacillus Anthracis* was probably the first bacterium to be recognised, inasmuch as it was associated with splenic fever as long ago as 1849. It is responsible for 'malignant pustule' in man. If an animal die suspected of the disease the mode of examination is to cut off the ear and submit the blood from the same to bacteriological examination.

The organism does not spore in the body of the animal, but if the air gain access, as in the case of an ordinary post-mortem investigation, the organism spores rapidly and hence becomes a grave source of danger.

The organism almost invariably occurs as long filaments, particularly in broth cultures (is non-motile). It grows on all the ordinary media both at room and body temperature, and produces in gelatin 'stab' cultures, typical 'inverted fir trees' appearance. By growing at 42° C. a non-sporing form can be produced, which is the mode of attenuation for the immunisation of animals, as introduced by Pasteur. The spores retain their vitality and pathogenicity for years in the dry condition. Martin has shown that the organism produces an alkaloid which is the fever producer and an albumose which induces the coma. The malignant diseases which the organism produce in man have been satisfactorily treated by Sclavo's Serum (*q.v.*) or by excision. If not diagnosed in time the organism may invade the blood stream, causing death, with symptoms of splenic fever, but the spleen is not so enlarged nor the bacilli so numerous in the organs.

Changes which occur in growth of the organism.—B.M.J. ii./11,1665.

Staining of the blood may be conducted by Gram's method (counterstaining with Eosin), also by Alkaline Methylene Blue. It is Gram positive.

Ultra Violet Rays by prolonged action transformed Anthrax Bacilli into a new type of organism which produced a new disease when inoculated into guinea-pigs. Possibly, given rays of sufficient penetrative power anthrax may be transmuted in the living organism.—Mme. Victor Henri, P.J. i./14,527.

Appendicitis.—Common intestinal parasites seem to be associated with this disease, *e.g.*, *Ascaris lumbricoides* and *Trichocephalus dispar*. Chauvel has pointed out that appendicitis appears to be the most prevalent among meat-eaters, and notably beef-eaters. It is, on the other hand, unknown amongst Arabs or the Chinese. In religious communities in Brittany where meat is never eaten, appendicitis is unknown.

Disease of the vermiform appendix may be initiated more frequently than is commonly supposed by entozoa, *e.g.*, *Oxyuris Vermicularis* and *Trichocephalus Trichiurus* may prepare the way for bacterial infection.—B.M.J. i./10,42.

"Wisp" Bacillus found in septic wounds—a small slender Gram +, non-motile. In V-shaped bundles something like the diphtheroid group. Grows in the depths of an agar or glucose-agar "shake" or "stab." Obligate anaerobe. In civil practice found in appendix abscess cases or other suppurations from the intestines.—A. Fleming, L. ii./15,642.

Beri Beri. *Syn.* A form of **Polyneuritis**.—This disease infests the Federated Malay States and parts of China.

Etiology. If not its origin, has at least an intimate relationship with the consumption of white or "polished" rice. No distinctive organisms have been found either in blood or urine.

Eykman first brought forward (1897) evidence to establish a close connection between the polished rice and the incidence of beri beri. The characteristics in man which arise from degeneration of peripheral nerves (polyneuritis), *viz.*, paralysis, muscle atrophy, contraction of the extremities have their counterpart in birds fed on milled rice. Feeding the latter with rice bran revives them.

Rice polishings comprise from 8 to 10% by weight of the original grain.

'Overmilled' would perhaps be a better term than 'Polished rice.' Rice thus 'polished' is deprived of pericarp, subpericarpal layers and embryo or germ.

It does not occur in races using partly milled "cured" rice. It has been found that the poorly nourished are more liable to contract it than those well fed.

Treatment.—Sir P. Manson (Tropical Diseases Manual), dwells on the importance of *Diet*. Rice should be eliminated. Vitamine-rich food (beans, peas, barley), wheaten flour—not overmilled—oatmeal to be substituted. Apart from other considerations, rice as food is too bulky. Yeast and rice polishings extract said to be curative. *Nitroglycerin* in full doses if acute cardiac distress. If sudden, *Amyl Nitrite*.

In the Philippines a preparation of rice polishings called Tiqui-Tiqui stated to be most efficacious for children.

The addition of *Phaseolus Radiatus* fruits to rice has also been advised *c.f.* Vol. I., p. 814.

Strychnine, Arsenic, and Silver Nitrate are in repute as soon as the muscular hyperæsthesia has subsided. A routine which has found some favour is the following :—

Magnesium Sulphate 60 grains, Dilute Hydrochloric Acid 20 minims, Tincture of Orange 1 drachm, Infusion of Calumba to 1 ounce. Thrice daily for a week, and repeat after a few days intermission.

If much œdema, the following may be of use :—

Solution of Ammonium Acetate 1 drachm, Potassium Nitrate 10 grains, Potassium Acetate 15 grains, Camphor Water to 1 ounce. Thrice daily.

If the heart shows signs of failure, a mixture of Digitalis, Ammonium Carbonate and Compound Spirit of Æther may be used with advantage.—Brocke.

Vitamines, *c.f.* Vol. I., pp. 577, and this Vol., p. 98, 104.

The Antiberi-beri factor is contained in rice polishings and in yeast. It has been shown to be the substance preventing polyneuritis. A few grains of pressed yeast are sufficient to cure a pigeon suffering from the disease. It is the sole curative agent (suggestions have been made that two substances co-operating together may be required.—*C.f.*, C. Funk, L. ii./13,83). It probably belongs to the Pyrimidine group and may be a constituent of Nucleic Acid.

Two methods of manufacture from Yeast are given.—B.M.J. ii./12,787.

The work carried out in the Institute for Medical Research, Kuala Lumpur showed that deficiency of *Phosphorus* is not the cause of beri-beri, neither is a glucoside responsible.—L. ii./11,1364.

Vitamines and malignancy.—Further experimental work on the growth of young animals by omission of certain constituents from their food.—B.M.J. ii./13,155.

Vitamines in general contain no Phosphorus, they are not fatty bodies and are distinct from lipoids. They are nitrogenous bodies (*e.g.*, the formula of one is $C_{26}H_{20}O_4N_4$) and are regarded as the mother substances of ferments and hormones. They are destroyed in 10 to 20 minutes at a temperature of 120—130° C., and also by extreme dryness.—T. Johnson, P.J. i./14,573.

The neuritis-preventing principle is insoluble in Ether, it is not inorganic, it is not volatile, but is destroyed by heat. It is absorbed by charcoal and cannot be recovered by water, Absolute Alcohol or Ether. Five Cc. of an extract equal to 5 grains of rice polishings were sufficient to protect fowls subsisting on polished rice, but 2½ Cc. were not.—Review of Tropical Diseases.—Pr., Aug. '13,218. See also Casimir Funk, B.M.J. i./13,814, and H. Fraser and A. T. Stanton, L. ii./14,398.

An adult accustomed to the use of polished rice would require 1.75 ounces of Vitamines daily. The active substance is soluble in 91% Alcohol.

Liquid Extract of Rice Polishings, made with acidulated Alcohol of strength 1 Cc.=10 Gm. fat-free polishings. Another liquid Extract prepared more thoroughly was also tried (1=5). This contains less Alcohol in the finished product. Effectual in animal experiments (cocks). Dose for adult human beings 2 drachms.—A. T. Stanton, L. ii./12,1005: see also L. i./14,98.

Rice Bran Powder in dose of 8 to 25 Gms. is also given.

The Anti-beri-beri vitamins occur in the aleurone layer of the grain beneath the husk and also in the germ of the grain. British flour owing to its excessive refinement, involving the almost complete removal of the aleurone layer with the husk, and also of the germ, is not protective against beri-beri. "**Atta**," Indian flour contains the aleurone layer and the wheat germ—this is protective against beri-beri. A mixture of the two used for our men. Yeast extract under the name **Marmite** also added to the British soldier's diet.—W. H. Willcox, L. ii./17,677. See also L. i./16,553.

Consult also *Vitamines* (Vol. I., p. 577, 578) and *Phaseolus*, p. 814, and this Vol., p. 98.

Blackwater Fever. *Syn.* MELANURIC FEVER.

Severe rigors generally at onset, bilious vomiting, hæmoglobinuria. Generally thought a form of malaria, but Manson places it by itself pending settlement. Analogy between this and the hæmoglobinuric fevers of cattle is striking.—Manson.

Notes on treatment :—Calomel 5 to 10 grains, Effervescent Saline. Intravenous injection of Normal Saline Solution, Quinine in nutrient enema (not milk), also Digitalis, and Strychnine in the same form.

A case of malaria suffered from typical blackwater fever had distinct pyrexial periods all differing as to plasmodia, fever and hæmoglobinuria. Some factor at work differing from the usual processes of ordinary malaria.—Prof. Ronald Ross.—L. i./11,585.

Blackwater fever, Causation of.—Colonial Reports.—L. i./13,260.

Quinine is not the cause of. Though the precise cause of blackwater fever is not known, there is evidence to show that malaria is the initial factor.—C. Christy, L. ii./17,486.

Adrenalin 20 minims every four hours useful.—J. A. Robertson, B.M.J. ii./19,272.

Blackwater Fever as complication in malaria. The ordinary antipyretics should not be used: sponging is generally sufficient.

Sternberg's Mixture. Sodium Bicarbonate 10 grains, solution of Mercuric Chloride 15 minims, water to 1 ounce. Every two hours for the first day and every three hours after until the urine clears. This in preference to ordinary diuretics.—D. G. Marshall, L. ii./18,417.

Blastomycosis.—Stoddard and Cutler have reviewed the entire subject of yeast organisms producing pathological conditions.—Rockefeller Institute for Research, Monograph No. 6, 1916, B.M.J. i./17,460.

Saline intravenously—1500 Cc.—A. Patrick, B.M.J. ii./18,404.

Botulismus.

Bacillus Botulinus.—This organism is found in a certain kind of meat poisoning designated 'botulismus.' An obligate anaerobe, motile—produces gas which splits up the medium in glucose agar stab cultures. It is Gram + staining. Has terminal spores.

Bacteria of Poisoned Meat.—B.M.J. i./05,1257.

B. Botulinus spores are highly resistant to heat.—Details *re* canning fruit, etc.—Y.B.P. 1919, 39.

Bungpaga.—A disease in the Gold Coast—a micro-organismal infection. Slides of pus show heavy infection of yeast cells. Painful tumours are formed in the affected muscles. It is thought to be caused and perpetuated by a yeast fungus in infected grain. The yeast cell is probably absorbed from the intestine in the same way as fat is by migratory leucocytes and thence into the general circulation.—C. R. Patton, B.M.J. i./16,483.

Cancer, Sarcoma, and other Malignant Tumours.

Imperial Cancer Research Fund Report (18th Annual Meeting).—Cerium Salts were found active in certain experimental conditions, but had no influence on growing tumours. Drew has approached the problem by studying the rate of decoloration of dilute Methylene Blue solution by normal and cancer cells. Decoloration is much more rapid with the normal. Russell and Gye have suspended tissue emulsions in fully oxygenated defibrinated blood and measured the rate at which oxygen is abstracted on incubation at body temperature. The more rapidly growing tumours, with exceptions, absorb more oxygen than those growing slowly. Respiration in normal tissues is a fresh line of research in connection with cancer.—Na., July 29/20,696.

Report for the Year 1914-15.—See B.M.J. ii./15,141.

For the Year 1915-16, see B.M.J. ii./16,299. **For the Year 1918-19** see B.M.J. ii./19,157.

The following is from the 9th Annual Report.—1910—1911:—

An important point which is brought out is that "the increase of cancer during the last decade is referable to certain anatomical regions and not to others,—thus in males the increase is almost confined to the alimentary canal,—especially the stomach, while in females it mainly affects the same system, stomach and intestines,

although the breast suffers also. Much has been done with regard to 'soil' investigation,—there would appear to be no special feature in it favouring the growth of cancer, for transplantable tumours grow as well in normal animals as in those in which they first appeared. Yet a spontaneous tumour can hardly ever be implanted into an animal in which there has arisen a spontaneous tumour. With regard to treatment, it has not been found possible to arrest growth of spontaneously arising tumours,—it is thought doubtful whether any real progress is to be made along these lines." Warnings as to irritation are repeated. Further, cancer is not "catching," and "cancer houses" cannot exist. Heredity plays a part in the development of cancer of the breast in mice. At all age periods the disease was more frequent when the mother, or either grandmother, or all three, had died from cancer of this organ. Resistance has not been induced either with an animal's own tumour or its own normal tissue. A number of cases of natural healing of spontaneous malignant new growths had been observed in mice affected with spontaneous cancer. "It is necessary to warn against needless alarm or the awakening of pessimistic anticipations of the outlook on future efforts to cope with cancer."—B.M.J. ii./II,171; L. ii./II,315,391. See also B.M.J. ii./II,1307; L. ii./II,1345.

The Fourth Scientific Report of the Fund showed that a portion of cancerous tissue transplanted to another part of the same body grows readily, while the attempt to graft it upon another individual is abortive or difficult. The cancerous overgrowth of tissue is usually, and perhaps exclusively, in some part of the body which has been subject to continuous irritation. Cancer of the generative organs has not increased at the same rate as that for other organs, and most of the increases affect the higher age-periods predominantly.

E. F. Bashford points out that the increase of cancer is real and not illusory—it is not due to a spread of infection. The common virus cannot exist for cat, mouse, and rat sarcoma, nor yet for sarcoma and carcinoma,—out of a pure adeno-carcinoma a sarcoma may develop in a certain number of instances. Embryonic mouse skin has extraordinary power of affecting a complete protection against mouse mammary carcinoma.

Dresden International Hygiene Exhibition.—B.M.J. ii./II,766.
Cancer—Bradshaw Lecture on:—

The living cancer-cell is the essential part of every cancerous growth, for when the cell dies it is impossible for any of the parts, agencies, or faculties of cancer to be excited or developed. In a successful graft the centrally placed cells die, but the peripheral portion of the transplanted tissue excites the surrounding fibrous tissue to form a support (stroma) for the tumour, whose soft tissues are wholly developed directly from the implanted living cancer-cells of the graft. Transfer of cancer from mouse to mouse is impossible if the vitality of the cancer-cells is impaired by pounding or by heat. On the other hand, inoculated infective granulomata show the fundamental difference that it is the host-tissue itself from which further growth results. A study of the cancer-cells demonstrates that it is only a variation of a normal cell, for it possesses neither in structure nor in power anything not found in the healthy cell. The established facts show that cancer-cells possess a great power of continuous multiplication, retaining inherited limitations to type of cells among which they first appear, but they develop and differentiate but little

and irregularly in a manner neither purposeful nor effective. Beckton has shown recently that the tissue-cells of man contain, with particular exceptions, certain granules, known as Altmann's granules, which are invariably absent in the cancerous growth proper. If this observation is confirmed it will not only be a very useful diagnostic character, but will also establish a morphological difference between cancer-cells and most normal cells, and afford anatomical proof that the former are not embryonic cells.

The potassium content of the red corpuscles of cancerous patients is approximately double that of healthy persons, although the amount of sodium is unchanged. Bashford has effected the artificial conversion of the malignant tumour of carcinoma into the soft cellular growths of sarcoma. This, as also the intimate connection shown between cancer-cells and the cells of the individual, make one unable to recognise in cancer an independent growth, parasitic or otherwise.

Cancer is cell-life that is disorderly, irregular, and with a minimum of development. It is a result of a breach of failure of fundamental cell-law—a law so majestic that obedience to it results in perfect health and disobedience to it means all the inscrutable woes of the dread disease.

Cancer is undoubtedly a disease that generally arises in cells that are growing, or have grown old, thus in woman the breast and uterus are prone to cancer as they get old before the rest of the body. The different incidence of cancer in the two sexes is not a sex difference affecting all the body tissues, but is the result of the special liability to the disease of organs possessed by one sex only. A chart given in the paper clearly shows the close parallelism of the cancer curve, in woman, and in their generative organs only (at 40 to 50 years of age), and the near approach of the curve for women, when we exclude disease of their generative organs, to that of men (at 50 to 60). Age, chronic irritation, x-rays, alcohol—all so-called causes of cancer—agree in being conditions that deteriorate the evolution of the individual cell and apparently lessen the latter's hold over the great primal cell-law. Cases of the disappearance of cancerous growths mentioned show that there is cure of cancer, apart from operative removal. "When the biologist shall know the laws that govern cell-growth, with a knowledge akin in its sweep and accuracy to that of the astronomer, he will have the power to prevent, to control, and to cure cancer."—Sir Alfred Pearce Gould. B.M.J. ii./10, 1836; L. ii./10, 1665; C.D. i./10, 933.

Imperial Cancer Research Fund, 1912, Meeting and Report including Fifth Scientific Report. The questions of immunity and spontaneous recession of transplanted tumours dealt with.—B.M.J. ii./12, 129.

Imperial Cancer Research Fund, Eighth Annual Report (1909—1910).

Statistics of 13,000 cases, examined microscopically, from hospitals in England and Scotland have been published. The methods suggested by various workers for serum diagnosis of cancer had yielded negative results. Attention had been paid to malignant growths in cattle. Histological types comprised the majority of forms met with in man. Frequency of primary carcinoma of the liver associated with cirrhosis and primary malignant growths of the suprarenal was of interest. Practically all mammary carcinoma of the mouse can be transplanted.

From observations showing the small proportion of successful transplantation of spontaneous tumours it is concluded that animals naturally the subject of cancer do not suffer from it because they present a soil uniformly favourable to the disease; on the contrary the circumstances associated with the appearance and growth of cancer are peculiar to the individual attacked. The cancer cell although highly dangerous to the individual in which it arises may hence be relatively innocuous to other individuals.—B.M.J. ii./10, 205; L. ii./10, 241, 265.

Mice immunised subcutaneously by injections of tumour or of normal tissue are resistant to the implantation of cancer in internal organs. The immune state is one of general distribution throughout the organism and not of local occurrence at the site of the immunising inoculation.—L. ii./11, 92.

For the Third Scientific Report (Seventh Annual Report) 1908 see last Edn., Vol. II., p. 287.

The chance of a man who reaches 35 eventually dying of cancer is 1 in 12, of a woman 1 in 8,—the figures for the two sexes are approximately as time advances.

A fragment of cancer tissue transplanted to a previously normal mouse induced an increase in the amount of physiologically active Hydrochloric Acid during digestion. Mice which had been apparently completely protected against the inoculation of cancer had developed the disease spontaneously. Cremation of all who die from cancer is essential.

Plimmer's bodies, which were considered peculiar to cancerous tissues, are also present in healthy reproductive tissues. This disposes of the idea hitherto held that Plimmer's bodies are parasitic organisms.

Chemical analysis of 300 tumours showed preponderance of Potash Salts and nucleo-protein content associated with high virulence and rapid development.

Living cancer tissues from English mice implanted on to newly imported foreign mice causes a certain amount of resistance to the growth,—only a small percentage of the inoculated mice develop tumours.—National Cancer Research Fund.

Tables giving relative frequency of cancer in various organs—male and female.—B.M.J. ii./11,1244.

The role of fat in the etiology of cancer.—It is possibly the tissue which plays an important part both in the etiology and certainly in the progress of the disease. Note the pigmented condition of the fat in some cases of carcinoma *p.m.* In operating on mammary cancer the oily and fluid state of the circummammary fat is very noticeable. In those cases where oophorectomy for inoperable mammary cancer produces disappearance of outward signs of the disease there is improvement in general health and increase in subcutaneous adipose tissue. **Chemical Examination of Fats.**—normal human and cancerous, gave interesting data. The fats were extracted by heat and examined for Iodine Nos. with Wij's Solution—there was decided difference in human fat before and after puberty—44.477 average Iodine value (= % of non-saturated fatty acids) between 9 and 11 years, and 60.88 between 16 and 19. Fat in health gave average Iodine value 62.1 and in cancer patients 72.62. Protoplasm according to latest views is an emulsion of proteins and lipoids, *i.e.*, there are cell fats, and any causes that make them more fluid lead to degeneration and destruction. What effects an excess of non-saturated fatty acids in the cells of adipose tissue of a part may have on surrounding somatic cells must be a matter of conjecture. Further research and enquiry necessary.—L. i./11,1560.

Predisposing causes, how cancer commences and spreads and diagnosis.—J. Rutherford Morison, B.M.J. ii./19,659.

Diagnosis of Cancer by examination of the blood:—

Antitryptic Index.—*The power of any given serum to inhibit tryptic digestion compared with that possessed by a normal standard serum.* The Antitryptic Index was found to be raised in 94% of cases of malignant disease. The reaction is, however, not specific, as most processes involving cell destruction produce a heightening of the index. The methods of obtaining the results are one chemical, another electrical, and a third by estimating viscosity of the serum.

Gastric ulcer can be distinguished from carcinoma of the stomach by the test. The electrical method registers more definitely than the chemical one,—details of procedure. The negative evidence afforded by a normal antitryptic index is of great value in excluding malignant disease.—B.M.J. ii./09,1220.

The electrical conductivity method is described. L. i./09,968. During tryptic digestion the rise of electrical conductivity of the digest is an accurate method of following the course of the reaction, and with it extremely small quantities of serum can be used.

Recognition of Cancer of the Stomach.—Stress has been laid in the diagnosis of carcinoma of the stomach upon the *absence of free Hydrochloric Acid* and diminution of the total acidity of the gastric contents removed after a test meal—there are, however, so many exceptions that too great importance must not be attached to it. In chronic gastric ulcer and in carcinoma, originating in chronic ulcer free Hydrochloric Acid is usually present in about normal amount—sometimes slightly in excess, and the total acidity corre-

sponds. In old standing cases which may be chronic ulcer, or may have overstepped the line and become malignant, no information of value is given. In chronic gastric ulcer apart from growth very rarely, in carcinoma of other organs commonly, and after severe hæmorrhage, free Hydrochloric Acid may be absent. These exceptions to be borne in mind in considering the value of absence of free Hydrochloric Acid and diminution of total acidity.—B.M.J. i./11,1458. *C.f.* Stomach Contents Examination, p. 462, 463.

Oleic Acid method of diagnosis of Gastric Carcinoma.—

The amount of Hübl's Iodine Solution, *vide* p. 85, necessary beyond the normal limits operating on gastric contents after a trial meal is taken to indicate presence of Oleic Acid.

Early diagnosis and treatment of cancer of the stomach. Evidence of impairment of the motor functions of the stomach, and of a diminution of the Chlorides in the gastric juice.—B.M.J. ii./10,953.

Reaction of the blood serum as aid in diagnosis of cancer.—

Titration using Dimethylamido-azo-benzene as indicator. The results show that some sera are more alkaline to Dimethylamido-azo-benzene than others.—B.M.J. ii./13,780.

Abderhalden's Serum Reaction has been used as diagnostic *q.v.*

A real increase of cancer cannot be proved. The stomach is the seat of the disease in nearly 22% of the fatal cases in males in England and Wales. In females the generative and mammary organs are affected in more than $\frac{2}{3}$ of the total cases. Whether cancer is transmissible by heredity in man has not been settled one way or the other. Importance of animal (mice) experiments being conducted under identical condition is emphasised. Old mice are not such good 'soil' for tumours as young ones. Animals can be rendered unsuitable for inoculation and growth of cancer by treating them with malignant new growths, or with normal tissues of their species. After exposure to **Radium** for an interval not long enough to cause any naked eye or microscopic alteration in the tissues, they may be completely deprived of their immunising or growing powers.

Cancer is not limited to white men. 25,000 deaths annually from it in Japan. It is not, as usually supposed, rare in any quarter of the globe.—E. F. Bashford.

In inoperable cancer the **thyroid gland** has been *removed* as the best means of ameliorating the disturbing factor. There would seem to be increased thyroid activity in carcinomatous sufferers.—L. ii./09,1138.

Cancer, like all "new growth," must be regarded in the light of an adaptive response on the part of certain cells or cell groups to changes in their environments, and as the result of a process of variation and selection of an "inter" or "intra" cellular kind.—C. J. Bond.—L. ii./11,349,391.

Cancer in cuirasse.—Long considered due to a malignant infiltration of the lymphatics of the skin, but W. S. Handley says it is an œdematous infiltration of the tissues due to lymphatic blocking. A paper upholding the original view.—L. ii./11,356.

IMMUNISATION BY RADIUM.—If a portion of mouse carcinoma be exposed to Radium for a period of time insufficient to produce a structural change, and this fragment be subsequently inoculated into other mice, the inoculation fails, no growth takes place, but the same result may be obtained by other methods, *e.g.*, breaking up the fragments in a mortar, or heating to 98.6° F. or 24 hours. In mouse carcinoma already established by inoculation exposure to Radium causes some tumours to disappear, others go on normally. Sections from the disappearing tumours show hæmorrhage where the Radium had exercised its influence, but the most noticeable change is an active proliferation of the connective tissues, especially at the margin, and an invasion of the parenchyma of the tumours by young fibroblasts. These contract on, strangle and destroy, the epithelial cells they embrace. There is no evidence of a direct specific effect on the epithelium of the growth which is found to be still actively proliferating.—L. ii./10,291.

The therapeutic value of Radium consists in its employment to treat conditions other than cancerous ones—it has no selective effect. Surgical treatment the only way.—E. F. Bashford.—B.M.J. i./11,1221.

See also **Radium, Therapeutic Use of.** This Vol., p. 323, *et. seq.*

Chronic traumatic mastitis caused by CORSETS improperly made or worn. Cases are also frequently seen where the position of cancer in the breast corre-

sponds exactly to the site of bone pressure of the stays. Patients should never wear anything that can act as a constant source of irritation, especially to epithelial tissue subject to such varying activity as that of the mammary gland.—G. L. Cheate. —B.M.J. i./11,492.

Local irritants causing Cancer. Details of the causation of epithelioma by the carrying of the cangri, a portable fire basket, by natives of Kashmir; also details of pitch cancer, or fuel workers' cancer. Incidence of cancer amongst workmen engaged in making fuel briquettes.—B.M.J. ii./10,629; i./11,885. See also L. ii./10,1830.

There is little evidence to show that cancer is an air-borne disease. Subcutaneous insertion of air-dried carcinoma produced no prophylactic immunisation to the growth of a subsequent graft, *i.e.*, that dead cancer tissue, whether killed by Radium or other means, was powerless as a prophylactic.—B.M.J. ii./10,1720.

Chemical irritants, Sulphurous and Sulphuric Acid, also **Tar** have been held responsible for cancer.

Sulphur content in fuel in relation to cancer. Peat is found in parts to be stronger in Sulphur than others and it appears cancer mortality is connected with high Sulphur content.—L. ii./13,506.

Gasworks Pitch and Cancer—Men handling pitch or engaged in making briquettes occasionally suffer from warty growths which may ulcerate and become the seat of epitheliomatous cancer, or particles of pitch strike the eyes and induce severe inflammation of the conjunctiva and cornea which may end in loss of vision.—B.M.J., i./13,36.

Briquettes and the incidence of cancer. The mischievous ingredient is an Amidine which distills at about the same temperature as Anthracene Oil, and is present in the rough Anthracene cake.—B.M.J. ii./13,506.

Liquid Paraffin is harmless and not likely to have any of the evils of pitch and tar in the cause of pitch cancer.—H. C. Ross and J. W. Cropper, B.M.J. ii./13,48. It is one of the later products of distillation of crude petroleum and is therefore probably quite free from "Auxetics" which have been found in the "interim Oil Scales" produced at oil works in Scotland.—B.M.J. i./15,445,530.

Genesis of cancer. An enquiry showing cancer to be explainable as an essentially physiological tissue change not associated with any external cause, *e.g.*, parasite.—A. Turnbull, B.M.J. ii./13,905. Cancer is a disordered growth of epithelium caused by irritants.—A. Paine, L. ii./20,693.

Cancer tissue cells are able to tear down the albumins of the body cell—in fact, to devour them. The reaction of the cancer cell is apparently acid, while the normal cell is alkaline—its chemical composition differs from that of the body cell. It is suggested that a substance may be found (given *per os*) that will have chemical affinity for the peculiar chemical constitution of the cancer cell. Cancer proteins exhibit a high content of Glutaminic Acid, Alanin, Phenylalanin and Aspartic Acids. The paper concludes, however, in praise of 'X' ray or Radium irradiation, combined with saturating the part with Aniline Dyes.—W. J. Morton, N.Y. Med. Jl., March 30th, 1912.

The late W. Forbes Ross held that cancer is due to want of balance in the mineral salts of the body. The intake of *Potassium* in particular, he held was deficient owing to process of cooking and diet.

Seventh International Congress of Medicine (1913—London).

Cancer occurs in practically every phase of life and in every species as an indirect result of chronic irritation, but what the direct or actual cause of the disease may be is not known.—E. F. Bashford.

E. Freund (Vienna), stated that normal blood contains a substance which has the power of destroying cancer-cells. He had isolated the substance, a fatty acid which is soluble in ether and does not contain nitrogen. It is not present in the blood in carcinoma, but in its place is found a substance which possesses the faculty of destroying the normally present fatty acid. His theory is that the deficiency and disappearance of the fatty acid must occur in advance of, and not as a result of, the growth of a cancerous tumour.

Clowes (Buffalo) had found that the virulence of tumours and their rate of growth are directly proportionate to the potassium content and inversely proportionate to the calcium-content, *c.f.* Forbes Ross *antea*.

Minute quantities of Radium present in most tissues,—much increased in cancerous tissue. Examination of gallstones (always associated with cancer) showed that while a mere trace of Radium is to be found in them in non-cancerous cases, 85 times as much is present in cancer of the bladder, and even when the cancer was elsewhere than in the gall bladder there existed an increase of Radium in the gallstones.

Radium can be removed out of solution by *Staphylococcus Pyogenes Aureus*. Bacteria form the common foci of gallstones. Possibly bacteria concentrate the Radium round themselves and so form foci of gallstones thus leading to cancer of the gall bladder.—W. S. Lazarus Barlow,—L. ii./13,729,704; C.D. ii./13,357.

Arsenic Cancer.—Arsenic may well be one of many predisposing causes. A case described of a woman who had psoriasis treated by arsenic and who ultimately died of cancer, also a table of numerous allied cases.—L. ii./13,210,284. See also Sir J. Bland Sutton, B.M.J. ii./16,788.

Uric Acid free diet in inoperable cancer. Results of trials of a diet of nuts, fruit, biscuits, etc.—A. Haig, B.M.J. ii./12,81,150.

Coley's Fluid.

Is prepared by cultivating the *Streptococcus* of erysipelas in bouillon ten days. *B. prodigiosus* is added, and the two are grown together for ten days. The culture is then killed at 60° C. *B. prodigiosus* has a curative effect on tumours, and intensifies the virulence of the toxins of erysipelas.

The method was founded on the occurrence of retrogression in, and disappearance of, inoperable sarcomata as a sequel to attacks of erysipelas. Six weeks to three months treatment generally sufficient.

The Lister Institute supplies 'New' Coley's Fluid (of red colour) in phials of 2 Cc. **Dose.**— $\frac{1}{4}$ minim at first, diluted with sterile distilled water, injected into the tumour or elsewhere, gradually increased until a temperature of 102° to 104° F. is produced.

Coley points out the necessity of following up this small dose by alternate local and *systemic* injections, also injections must be given until all reaction has calmed down and the temperature fallen.

Mixed-cell sarcoma treated locally, excision and Coley's Fluid $\frac{1}{4}$ to 3 minim doses, successful.—B.M.J. ii./13,1484.

Fresh alarms on the increase of cancer.—E. F. Bashford, L. i./14,378.

For further methods of treatment of Cancer consult the **Therapeutic Index**—Vol. I. p. 967.

Cerebro-Spinal Fever.

For a detailed account of characters, types of the *Meningococcus*, *Bacteriology and Diagnosis* (West's Swab, Cambridge Hospital Medium, Congo Red Blood Serum), *Treatment and Disinfection of Carriers*, *Lister Antimeningococcic Serum*, *Flexner's Serum and Vaccine*, see Vol. I., p. 849 et seq.

Meningococci may be occasionally found in peripheral blood films by using Giemsa's stain.—A. C. Coles, L. i./15,750, 828, 1046.

C.S. fever treated by univalent serum intrathecally (20 Cc.).—H. S. Banks, L. i./20,591.

Trypagar as a medium for culture of the meningococcus. Contains pea flour extract and Trypsin broth as follows:—

(1) Pea Flour Extract.

Mix Pea flour 100 Gm., Salt 100 Gm. with a litre of Distilled Water. Steam for $\frac{1}{2}$ hour with occasional stirring. Allow to settle and filter. Make fresh for each batch of Trypagar.

(2) Trypsin Broth (Douglas).

To each $\frac{1}{2}$ kilo of fresh bullocks' hearts freed from fat and vessels and minced fine add 1 litre of water and make faintly alkaline to litmus with 20 % Potassium Hydroxide solution. Heat slowly to 75 or 80° C. 5 minutes. Cool to 37° C. and add 1 % of Liq. Trypsin Co. and keep at 37° C. for 2 $\frac{1}{2}$ to 3 hours. Test for adequate peptonisation with Biuret reaction as below. Then render slightly acid with Glacial Acetic Acid and bring slowly to boil for $\frac{1}{4}$ hour. Leave over night in a cool place and decant the clear liquid. Make faintly alkaline to litmus and sterilise in autoclave at 118° C. 1 hour on each of two days.

To Make Trypagar.

Add 2% of Agar to Trypsinised Broth made as above and 0.125 Gm. Calcium Chloride per litre. Autoclave at 118° C. for $\frac{3}{4}$ hour to dissolve. Titrate a small quantity after well mixing, with N/10 Potassium Hydroxide while boiling (Phenolphthalein) and add KOH *q.s.* to the bulk to make *neutral*. Cool to 60° C., add white of egg with shells (two to the litre) and autoclave again at 118° C. for 75 minutes or in the steamer for 2 hours. Filter and add 5% Sterile Pea Flour Extract above and sterilise in the ordinary way.

The agar is directed to be cut up and washed with Dilute Acetic Acid (2.5 Cc. of Glacial per litre of water) and again washed thoroughly before use.

Sterile Blood Serum is directed to be added to the Trypagar in the proportion of 2% for use in primary cultures at the time of cultivation.

Biuret Reaction.

To 5 Cc. of broth add 0.1 Cc. 5% Copper Sulphate Solution, mix and add 5 Cc. N/1 Sodium Hydroxide. A true pink shows adequate trypsinisation. Bluish purple is incomplete.—Lieut. Col. Gordon, Maj. T. G. M. Hine, Capt. M. Flack, B.M.J. ii./16,678.

Chemical factors involved in growth of the meningococcus. The organism needs *vitamines* as in Gordon's Peaflour Extract for its primary growth *in vitro*, but during the early stages of subculture this need becomes greatly diminished. After a certain number of subcultures the organism will grow vigorously on a vitamine-free medium, providing there is an abundant supply of free amino acid. The tryptic digest of Casein (Cole & Onslow) fills these two conditions.—B.M.J. i./17,11.

PERMANGANATE TEST FOR CEREBRO-SPINAL MENINGITIS.—(Lundie and others).

In cerebro-spinal meningitis the cerebro-spinal fluid is sometimes reduced so much that only a few drops can be obtained, but they usually contain pus cells and micro-organisms. In other cases a clear fluid which is sterile is obtained on puncture; no pus or formed matter at all on centrifuging. It is, however, mostly abnormal chemically.

Normally cerebro-spinal fluid contains 5% dextrose, salts and about 0.02% globulin. All cases under examination contained excess of albumin or albumose and in the cases examined for sugar there was a loss of sugar but never complete absence.

Normal cerebro-spinal fluid is rendered pink by addition of 1 in 1000 Potassium Permanganate Solution and remains pink for at least 5 minutes but in meningitis the clear fluid promptly becomes yellow. This may be due to reduction of a glucose fermentation product, the result of enzyme action.—A. Lundie and co-workers, B.M.J. i./15,628.

The test is certainly of value but there is a doubt that a positive reaction may be obtained in septic non-meningitic cases. A quantitative modification was tried. The name *Diplo. Intracellularis* thought to be a misnomer. Some extracellular diplococci found in large percentage of cases.—W. J. Denehy, B.M.J. ii./16,684.

Mutability of Organisms. The meningococcus and other bacteria—data supporting.—B.M.J. ii./16,604.

Bacillus Coli Communis. A normal inhabitant of the intestines, but becomes virulent in certain conditions. It increases the virulence of typhoid. The *Bacillus Coli* is present in an infant a few hours after birth. For further characteristics see *B. Typhosus* and Bacteriological Examination of Water.

Bacteriology of Fæces.—Bacteria in fæces which constitute about one-third of the dried weight are (a) digestive and (b) antiputrefactive and antiseptic. *B. Coli* is the chief bactericidal agent. It is destructive to nearly all bacteria except *Staphylococcus* and *Streptococcus*, and the other important defence is the intact intestinal mucosa. If either of these become defective, an enormous development of injurious and actively fermentative germs occurs, such as *B. acid. putrifici coli*, *B. liquefaciens*, etc. These, by their toxins and ferments, act upon the mucous membrane, destroying its continuity and giving rise to ulceration, creating a "vicious circle," the disease of the bowel altering the bacterial flora, and the bacteria increasing the ulceration; and the products of these secondary infections, when increased in amount, give rise to auto-intoxication with its accompanying constipation, headache, neurasthenia, etc., and in its later stages to arteriosclerosis and its attendant evils.—Pr.

Bacteriology of the alimentary canal,—an exhaustive treatise.—F. W. Andrewes, B.M.J. i./13, 539.

Could not be found in London air. Desiccation necessary for it to gain access to the air, which is generally fatal to this organism.—Hewlett.

BACILLURIA occurs with great frequency. 1. Associated with passage of pus; single abscess or more widespread infection of the urinary tract. 2. Milder stage—continuous passage of the bacilli but without pus or epithelial cells. 3. Intermittent passage of the bacilli. One often finds a history of constipation and a large proportion of cases are women.

In examining urine in which pus is absent one should note (a) Pale colour, paler than one would expect from the gravity. (b) Low acid reaction; rarely very acid. (c) The urine is hazy, not clear. Filter a little, if still cloudy, examine under the microscope: ($\frac{1}{2}$ inch oil immersion). Round bodies or short rods (the former are the bacilli 'on end'). Note motility. Stain centrifugalised deposit by Gram's method. It is Gram negative. The urine should be fresh and collected in sterile flask by catheter if possible. Inoculate an agar tube with a large loop full—note opaque white growth after 24 hours with crenated margin.

Variability in the Gas-forming power of Intestinal Bacteria. It is possible to select a strain of *B. Coli* which fails to produce gas from certain Mono, Di-, and Poly-Saccharides.—P.R.S.M. Path. Sectn. 1911, p. 97.

B. Coli infections with reference to their recognition and comparative frequency:—

Accidental scalds on a child's buttocks developed diarrhoea, convulsions, temperature 104° F. Specimen of the fluid from the blisters on cultivation on Agar were found to yield pure growth of *B. Coli*,—infection being caused by child's motions. Cultures from the sputum and the urine of an anomalous febrile case gave a small bacillus, motile and —Gram straining. Fermented glucose and lactose with gas production; produced clotting and acidity in litmus milk. Production of Indol was not clear. There was no indication or stoppage of motility when the organisms were brought into contact with the patient's blood 10:1. The last negative result is not evidence of any great weight against the conclusion that the bacilli had a specific connection with the patient's illness. A mild coli and pneumo infection was diagnosed. In another case definite agglutination was obtained which coupled with + Indol reaction and other characters as above detailed, justified conclusion of *B. Coli* infection. Vaccine given.—B.M.J. ii./10, 1301.

The **typical characters** of *B. Coli Communis* are as follows:—

1. The formation of Indol in broth culture—identified by the intense redness produced by **Ehrlich's Rosindol Reaction**, *Syn.* Böhme's Indol Test—addition of Paradimethyl-Amido-Benzaldehyde (1% solution in Absolute Alcohol and Hydrochloric Acid) and Saturated Solution of Potassium Persulphate. To conduct this test, see Bact. Examination of Water, p. 424:

2. The coagulation and acidifying of Litmus Milk.

3. The acidifying of McConkey's Fluid with gas formation.

4. The reduction of neutral red to yellow fluorescence.

5. The growth of red colonies on Conradi-Drigalski's Medium (see p. 425).

6. The formation of gas in glucose gelatin 'Shake' culture at 22° C. without quefaction of the gelatin.—B.M.J. ii./10, 1133.

Specific differences amongst bacteria. The varieties of *B. Coli* are almost infinite.—L. ii./13, 1241.

The presence of anaerobic bacteria is believed to account for abnormal putrefaction in the intestine—normally the bacteria are either aerobic or facultative anaerobes—mainly whilst the anaerobic are in the minority. Excess of the anaerobic bacteria may be caused by excess of animal food,—auto-intoxication can undoubtedly be traced to this. Again the food may be excessively contaminated with bacteria, *e.g.*, in pyorrhoea alveolaris, and post nasal catarrh. Further, it may pass from the stomach imperfectly digested. There is in addition purely intestinal putrefaction. One of the agencies of defence by nature against such injury is the combating of toxins by the intestinal flora—principally *B. Coli*—this organism is furthermore stated to produce thermolabile and thermostable substances which not only inhibit the growth of other organisms, but also their own if given long enough time to act.

Diagnosis of abnormal putrefaction may be assisted by estimating (1) URINE, increase in ethereal sulphates in the urine; increase in total output of

aromatic bodies ; rise in capillary constant ; examination for Indican and other constituents. (2) EXAMINATION OF THE FÆCES,—staining by Gram's method and counterstaining with neutral red—the *red organisms should preponderate* (*B. Coli* is *non* Gram Staining). In abnormal putrefaction in proportion as the aerobic bacilli are replaced by strict anaerobes (mostly + Gram) the blue stained will be in excess. A loopful of a 1 in 100 suspension of fæces in sterile milk should not produce a rapid gas formation (*e.g.*, by *B. Aerogenes Capsulatus*).—G. Herschell.

B. Coli in urine is sometimes seen joined end to end forming a spirillum-like structure. It will grow both in urine rendered artificially many times more acid than normal, also in alkaline urine—*more readily in acid*.—A. Jordan, B.M.J. ii./13,649.

BACILLURIA AND PYURIA.—Estimate the Acid Index by titrating 10 Cc. of the urine with N/10 Sodium Hydrate using Phenolphthalein. If low, administer Acid Sodium Phosphate thrice daily in order to increase the acidity up to even 10° and to keep it up. Albumin (due to Globulin probably due to Leucocytes) may be found, also Acetone.

The chief bacteria concerned are *B. Coli*, *Streptococci* of the long type, which are more feebly Gram + than *St. Pyogenes*, *Staphylococcal* forms, and "Beaded" bacilli of the *B. Xerosis* type, further a great variety resembling *B. proteus vulgaris*.

All of these have been found in bacilluria with joint troubles, but the most striking cases afforded almost pure culture of streptococcal form. They closely resemble the *streptococcus salivarius*, a common inhabitant of the throat. Tubercle bacilli should always be looked for, especially if lymphocytes are present. Pneumococci are said to occur, but in connection with acute cases, while gonococci play an important role by themselves.—Wyatt Wingrave, Pr. Dec. 1912.

B. Coli will grow equally luxuriantly in either alkaline or acid urine.—L. ii./12,1208.

For the effect of Formaldehyde upon this organism (*i.e.*, on treatment with Hexamine and Sodium Acid Phosphate), see our investigation, p. 77 and 78.

B. COLI IN THE BLOOD.—Blood cultures made from persons suffering from undoubted *Coli* infections are almost invariably sterile. On three occasions pure growths of the bacillus were obtained from the blood. In two cases they were obtained whilst patients were actually suffering from a rigor and in the third 3½ hours after a rigor.—L. ii./12,1500.

Tuberculosis, rheumatism and many other chronic diseases thought to be the effect of the toxins which pervade the tissues as a result of absorption from the intestine in chronic intestinal stasis. Far reaching results are being achieved by the treatment of tuberculosis with detoxicated *B. coli* and other organisms.—White Robertson quoted by A. C. Jordan, L. i./20,760.

For **Musgrave's Medium** for cultivating *B. Coli*, see Culture Media.

For *Distinction and Separation from B. Typhosus* vide Bact. Examination of Water and *B. Typhosus*.

Dhobie's Itch.—Manson states many cases are produced by *Microsporon minutissimum* and are really inflamed erythrasma and not trichophyton ringworm.

Vlemingkx's Solution usually cures—used at first diluted three or four times if parts are inflamed.

Bacillus Diphtheriæ.—The latest work leads to the opinion that this organism is of the nature of a Streptothrix. *Directions for collecting specimens.*—If a sterile swab is not at hand (which should be used with aid of a tongue depressor), a small piece of absorbent cotton wool (not medicated with an antiseptic) should be steamed, *e.g.*, at the mouth of a kettle, allowed to cool and rubbed over the membrane on the fauces of the patient and removed in a test tube or bottle which has been similarly sterilised. If possible a small portion of the membrane should be detached in addition. The organism may persist for many months in nasal and aural discharges.

The organism in dry condition and in the absence of light has been shown to persist for many months, an important point to recollect in disinfection of bed linen. Moist heat destroys the organism rapidly, *e.g.*, a temperature of 60° C. Is also very sensitive to treatment by antiseptics. Nurses in charge

of patients should be examined occasionally as the organism may be present without symptoms of illness and infection by such agency should be guarded against. An injection of Antitoxin is a safeguard.

Films are prepared from the swab. Stain with Borax Blue, counterstain with Vesuvine or by Gram's method (Gram +). Dry and mount in xylol balsam.

Recognition.—*B. diphtheriæ* may be distinguished from the other organism which will probably be seen in large numbers by the following characteristics—Irregularity in size and outline, straight or slightly curved, more or less clubbed at one or both ends (clubs chiefly in cultures), sometimes spindle shaped, or as curved wedges, occasionally irregularly segmented, rarely or never regular in outline. Parallel grouping and 'Chinese alphabet' characteristic. Stain irregularly. Show irregular beading with Borax Blue and Vesuvine, which is the best stain to demonstrate the granules—and Gram's method, v.p. 556. **Cultivate on blood-serum**—fine cream-coloured growth in twelve to sixteen hours, film from the same stain with methylene blue, Neisser's or Gram's method. Cultivations should in all cases be made on blood-serum or glycerin agar before the result of diagnosis can be positive. Further characteristics,—no spores, non-motile. Form differs with culture medium.

Neisser's method of staining the organism:—

Stain $\frac{1}{2}$ minute each (washing between with water) with

A. Methylene blue, 0.5 Gm.

Alcohol absolute, 10 Cc.

Distilled water, 475 Cc.

Glacial acetic acid, 25 Cc.

B. Bismarck brown, syn. Vesuvine $C_6H_4NH_2.N_2.C_6H_3(NH_2)_2.2HCl$.
1 Gm.

Distilled water, 500 Cc.

The length of time each stain is used has been much altered by various workers. Originally it was a matter of 3 seconds with A. and 10 seconds with B. The method can be used for examining direct from the swab.

The use of Eosin Solution instead of B. above gives good results, working as follows:—

1. Make film in usual manner. 2. Stain with A. three minutes, and without washing pour on Gram's iodine solution 1 minute. 3. Wash in water and counterstain with eosin 5% aqueous solution 3 minutes, wash dry and mount. This method was claimed to be diagnostic, but other organisms, *e.g.*, *B. Xerosis*, *B. Proteus Zenkeri*, *B. Cyanogenus*, and various organisms found in water, give similar results. The granules are stained blue, the rest of the bacillus is stained by the counterstain.

Good results direct from the swab are obtained by the following:—Stain with Alkaline Methylene Blue (v. p. 539) 3 to 4 seconds, afterwards with B. above.

Toluidine Blue Stain for.—Toluidine Blue 0.02 Gm., Glacial Acetic Acid 1.0 Cc., Absolute Alcohol 2 Cc., Water to 100 Cc. A loopful of the Stain is dabbed on the dried smear and examined as hanging drop with $\frac{1}{12}$ th inch oil immersion lens. Used for direct examination from the swab, the appearance is characteristic. *B. Diphtheriæ* appears pale blue with bright and often deeply stained red granules along its entire length, some yeasts and sarcinæ also show the metachromatic markings. Hoffman's bacillus stains dark blue with a light band. Diphtheroid bacilli cannot be mistaken or confused with *B. Diphtheriæ* by the method. It would be well to make the film, if possible, direct from the throat. A negative result is not to be considered of much value. Vincent's angina fusiform bacilli also stain dark blue. The method is claimed to be simple and rapid.—Constant Ponder L.ii./12,23.

Two reputed pseudo-varieties; one morphologically and in all respects similar to the specific organism, but non-virulent, the other of **Hofmann** shortly after the latter—stains more regularly than the diphtheria bacillus and usually shows no polar staining. Uniform in shape, size and staining.

The general trend of opinion is that the *Hofmann Bacillus* is quite distinct but Hewlett thinks that the *Hofmann Bacillus* really includes several species of which one may be a modified form of the diphtheria bacillus.—B.M.J. i./12,75.

Morphology of the bacillus varies greatly. From different individuals one may obtain (a) uniformly cylindrical bacilli with deeply staining round or oval terminal granules and the rod varying in length, or (b) very irregular in size and staining, and may be slightly curved. Further there seems to be *seasonal prevalence*; thus the *cylindrical* form, while it may prevail throughout the year appears to *predominate in winter* and *be irregular in summer*.

Pathogenicity of true Diphtheria Bacillus compared with pseudo forms.

Five Cc. of a glucose-broth culture two days old with pseudo-diphtheria bacilli are not pathogenic to guinea-pigs, whereas $\frac{1}{2}$ Cc. of a similar culture of true diphtheria bacilli usually kills in two days.

Glucose Litmus Broth cultures of true diphtheria bacilli show marked acidity in 24 hours, while those of the pseudo forms are stated not to evince this alteration of reaction. *This method is useful for confirmation where no licence for inoculation of animals is held.*

Serum-water gives good result:—

Coagulate blood serum in an equal quantity of water, filter, add to one half. 1% glucose, and to the other 1% Saccharose. Add neutral red as indicator. After 24 hours a marked acid is produced in the glucose tube by *B. diphtheriæ* in both the glucose and the saccharose tubes by *B. Xerosis* (*vide infra*) and no change is produced in either tube by Hofmann's Bacillus.

B. Paralyticans longus and *B. paralyticans brevis* (**Muirhead's Diphtheroid Bacillus**).

B. Xerosis occurring in xerosis conjunctivæ, also in nose, throat and ear, differs in the fact that primary cultures from the eye on blood serum first appear in 36 hours. Sub-cultures do not show this difference. The organism is non-pathogenic to guinea-pigs.

Characters. Gram + and very similar to *B. diphtheriæ*: often occurs in the throat.

Koch-Weeks bacillus, a thin, non-motile organism decolourised by Gram's method, is found in a large number of cases of conjunctivitis. A diplo-bacillus has also been found which causes an extremely dangerous form of conjunctivitis, but it is amenable to treatment.

B. Morax-Axenfeld.—Angular conjunctivitis is the only form of conjunctivitis in which the clinical appearance is characteristic of the organism at work—the diplobacillus of Morax-Axenfeld (Gram-). Boric lotion and Zinc Sulphate 0.5% rapidly effects cure.

Potassium Sulphocyanide Medium for differentiation of *B. Diphtheriæ* and associated organisms,—Potassium Sulphocyanide 1, Calcium Chloride 1, 1% Aqueous Neutral Red Solution $\frac{1}{2}$, Glucose $\frac{1}{2}$, Broth 25, Sheep's Serum 75, adjusted so that on coagulation the reaction is faintly alkaline: Found of service for the routine recognition of *B. Diphtheriæ*, *B. Hofmanni*, *Torulæ Micrococci* and *B. Subtilis* by subcultures. Colonies of *B. Diphtheriæ* almost invariably a bluish pink tint with diffusion of the tint through the medium. —Jl. Path. and Bact., July, 1911, 130. The following Media are on similar lines:—

To Sheep's Blood Serum to which has already been added 1% Glucose and 1% of $\frac{1}{2}$ % Solution Neutral Red indicator (this preliminary combination being denoted as "S") there is added either singly or in combination one or more of the following:—

(A). Potassium Sulphocyanide 1%. (B). Potassium Ferrocyanide $2\frac{1}{2}$ %. (C). Potassium Ferricyanide 1%. (D). Boric Acid 1%.

The Medium on coagulation and inspissation should be faint primrose-yellow in colour and faintly alkaline. The Sheep's Serum is best pipetted off from recently drawn clotted blood and then allowed to stand in a refrigerator for three days in order to eliminate red corpuscles by sedimentation, only the supernatant liquid being finally utilised. With combination 'S.A.' *B. Diphtheriæ* grows red with a bluish-pink tint diffusing through the medium in all directions; *B. Hofmann* grows yellow with yellowish diffusion. Some varieties of Staphylococci simulate *B. Diphtheriæ* on culture, but on further incubation the tint does not intensify as with *B. Diphtheriæ*, and should be readily distinguished; *B. Subtilis* grows brownish, *B. Megatherium* and *Torulæ* grow as faint pinkish-white colonies, which are raised; *Streptococci* grows

apparently colourless. Combinations 'S.A.B.' 'S.B.' and 'S.D.' in particular show up to advantage the reddening and bluish-pink diffusion brought about by *B. Diphtheriæ* as compared with various *Staphylococci*. The general rule may be taken as "No red coloration no *B. Diphtheriæ*." This coloration may be seen with the naked eye and hence has advantage for rapidly identifying subcultures from swabs of suspicious nose and throat cases.—B.M.J. i./11,759.

Potassium Tellurate Culture Medium.

Meat Extract 10 Gm., Salt 5 Gm., Witte's Peptone 20 Gm., Acid Calcium Malate 6 Gm. to 1,000 Cc. of Water. Heat for half an hour and filter, and add 1% Glucose and three times its volume of Sterile Ox Serum. To each 100 Cc. of the mixture 2 Cc. of a 1% Potassium Tellurate solution are added, and the result poured into a Petri dish and coagulated by heat. The material to be examined is first incubated for three hours on Blood Serum, after which the plates thus prepared are inoculated from the cultures thus obtained. The diphtheria bacillus has the power of converting the tellurium salt into tellurium dioxide, which stains the colony black; pseudo-diphtheria bacilli form colonies of a grey colour, whilst those of staphylococci are brown. Most other organisms grow badly in this medium.—Conradi and Troch, Munch. Med. Woch., Vol. LIX., p. 1,652. Pr. Feb. 1913.

Sections of Membrane.—Stain for the diphtheria bacillus by the Eosin-Gram method:—

1. Stain 4 or 5 min. with eosin solution. 2. Wash well in water. 3. Pass through a little alcohol. 4. Stain with anilin-gentian-violet, 10 min. 5. Cover with Gram's iodine solution, 3 min. 6. Decolorise with anilin oil. 7. Clear with xylol and mount in xylol balsam.

Roux's Stain for Bacteria.—Dahlia or Gentian Violet 0.5 Gm., Methyl Green 1.5 Gm., Distilled Water 200 Gm.

Diphtheria Antitoxin, Serum Antidiphthericum.

Preparation of Diphtheria Antitoxin.

Consists of the fluid separated from coagulated blood of the horse immunised by inoculation with diphtheric toxin, produced by the filtered culture of the *Bacillus diphtheriæ* in broth—a surface growth is important. Repeated injections during 4 to 6 months of increasing quantities of toxin up to as much as $\frac{1}{2}$ or 1 litre render the serum of a high antitoxic quality. When the horse's serum reaches the stage at which a combined injection into a guinea-pig of serum *plus* a dose of toxin leads to no symptoms of diphtheria, it is considered to have attained the required potency. The horse is bled about 10 days after the last injection and the serum prepared for use as a remedy, and as a prophylactic.

That of P. Belg. and P. Jap. must be marked with the name of the maker, date, and rotation number, also the number of units per Cc. in the vial. Similar remarks apply in the case of the U.S. preparations. '**Concentrated Diphtheria Antitoxin**' is dealt with in Vol. I., p. 857. Keep in the dark in a cool place. P. Jap. states the serum must be sterile. This pharmacopœia has:—

(A) *Serum Antidiphthericum Liquidum*, which should possess not less than 500 units in 1 Cc. Three Classes—No. 1 contains 600 antitoxic units; No. 2, 1,000 a. units; No. 3, 1,500 units. Injected subcutaneously, 0.5 Cc. should not kill a mouse of 15 Gm. weight, nor should 10 Cc. be fatal to a guinea-pig. (B) *Serum Antidiphthericum Siccum* 1 Gm. represents at least 5,000 antitoxic units.

Units of Immunity.

The E. B. Unit refers to the toxin **neutralising power** of the serum not to the volume of the liquid. A normal serum is prepared for comparative purposes: 1 Cc. of this contains 1 unit of immunity, and 0.1 Cc. of it neutralises 1 Cc. of normal standard toxin.

The strength of sera is ascertained by physiological tests on guinea-pigs, weighing, as near as possible, 250 Gm., using mixtures of different quantities of the serum, and a lethal test dose of standardised toxin. The neutralising point is indicated by the animal's death being prevented on the fourth day.—For further details consult Hewlett, P.J. ii./04,377.

Preservation.—There is marked loss in antitoxic value in liquid serum at room temperature,—e.g., in 2 years a loss of over 30% has been determined. Dried diphtheria antitoxin, on the other hand, kept in the dark at 5° C. retained its potency for five years.

References to the use of Diphtheria Antitoxin.

The earliest report of the use of the antitoxic serum (by Behring & Kossel) is found in the Deut. Med. Woch. of April 27, 1893; this is noted in B.M.J. i./93,83.

First English reported case by Eastes, 5 Cc. of Aronson's preparation in a child of 10 years, with recovery.—B.M.J. ii./94,125. Second,—p. 180.

Diphtheria of the skin—the primary seat of infection being the eyes—thence to the vulva and the lower part of the face, has been satisfactorily treated with antitoxin.

In erysipelas in some cases the injection of Diphtheria Antitoxin causes rapid fall of temperature with disappearance of skin manifestations.

Diphtheria, malignant with multiple lesions in a child six weeks old failed to respond to 12,000 units of Antitoxin.

Pigeon diphtheria has nothing to do with human diphtheria.

In diphtheritic conjunctivitis must be used early. If no response a mixed infection may be present.

1,550 cases of diphtheria—78 of which were hæmorrhagic—treated with high doses of Antitoxin. As a rule not more than 1 injection daily,—the maximum at one time rarely exceeding 24,000 units. Subcutaneously preferred. Adrenalin given internally.—M.P. Oct. 1909,390.

Oral and Rectal Use of Antitoxin.

In quinsy or bad scarlet fever throats,—per rectum has been advised.

Antistreptococcic Serum in diphtheria is as efficacious given per rectum as hypodermically.—B.M.J. i./07,20.

Serum by the mouth,—smaller dose than hypodermic, 2,000 units, followed up, if necessary, by a further dose.—B.M.J. ii./11,108,1235.

Should not be given *per anum* or *per os*.—Hewlett.

Boils and septic conditions in young children have been well treated by Diphtheritic Serum. Specific characters of Sera doubted, effect thought to be due possibly to a by-product,—a nuclein derivative,—in the serum. Asthma has also been benefited,—dose given 1,000 units repeated at intervals.—Aikman, Guernsey.—B.M.J. ii./09,1016.

In diphtheria the use of Alcohol which used to be taught as imperative owing to frequency of heart failure has been found to interfere with the acquirement of immunity, also that in diphtheria heart failure is due to nerve degeneration caused by the diphtheria toxin, therefore Alcohol is contra-indicated. Antitoxin was freely given—there were 11 deaths in 114 cases.—L. ii./11,110.

Diphtheria,—two unusual cases. After childbirth a woman had a parotid abscess in which *Staphylococci* were found. Later the voice became husky, there was respiratory stridor, and she died. Post mortem,—a diphtheritic membrane in which *B. diphtheriæ* was found extended from the vocal cords to below the bifurcation of the trachea. The other case was a nurse who had attended a bad case of septicæmia. Patient developed high temperature and great cyanosis and failure of strength. *B. diphtheriæ* was found in sputum, etc., without ordinary clinical signs of diphtheria. Serum was of no avail.—L. i./13,691.

Diphtheria Carriers are found of all ages and of either sex, the presence or absence of an obvious pathological condition is no criterion for detecting a carrier, of the length of carrier life, or of virulence. • The length of carrier life seems to have no effect on virulence,—bacilli have been demonstrated to be virulent after four and eight months in the ear and nose of different individuals. The transference from animal to human is rare. Further prosecution of work may result in finding harmless organisms where implantation and growth on diphtheria-infected persons may result in ousting the bacillus diphtheriæ from its usual haunts.—L. i./11,795. See also B.M.J. ii./10,1508.

The length of carrier-life of the bacillus appears to have no effect upon its virulence since the organism has been proved to be virulent after four and eight months in the ear and nose. A. Graham Macdonald outlines his scheme for dealing with the disease.—L. i./12,662.

Schick Test in Diphtheria.—The administration of minute doses of Diphtheria toxin. A standard diphtheria toxin is diluted at first 1:10, in 0.5 % phenol; this dilution will keep in the ice box for at least two weeks. For use, further dilutions are now made in normal saline, of such strength that 0.1 Cc. contains 1/50 minimum lethal dose for the guinea pig. This

amount is injected intracutaneously on the flexor surface of the arm or forearm. If antitoxin is absent in the patient or only present in small amount insufficient for protection a circumscribed area of redness persisting 7 to 10 days is produced and on fading shows superficial scaling and persistent brownish pigmentation. Enables one to differentiate individuals who are susceptible from those who are not susceptible to diphtheria.—L. i./15,32; i./20,192.

Diphtheria Endotoxin. (Macfadyen) *c.f.*, Vol. I., p. 858. 24 cases so far treated—good result. Doses now recommended—0.5, 1.0 Cc. and if required 1.5 Cc. at intervals of about 7 days in the muscle of the upper arm or back.—R. T. Hewlett, L. i./15,275.

“Positive Throat” in diphtheria convalescents treated by stock **Vaccine**. Dose 10 to 200 million. Well defined degeneracy in morphological appearance of the cultured organism followed by complete dispersal from the locality invaded.—J. L. Brownlie, L. i./20,706.

UNTOWARD RESULTS, SERUM RASHES, ETC., WITH DIPHTHERIA ANTITOXIN.

A case in which 3,000 units of serum were injected, and in less than 10 minutes patient's eyelids began to swell, involving the whole in less than an hour. Lips thickened and the whole body was covered with an urticarial eruption. 20 grain doses of Calcium Chloride every 2 hours—swelling disappeared in 14 days.—B.M.J. ii./09,95.

Calcium Salts as prophylactic against serum rashes.—L. ii./11,1694.

Should be administered with great caution to asthmatic patients, even as prophylactic.—B.M.J. ii./09,356.

Anaphylaxis to Diphtheria Antitoxin.—Intense itching, subsequently vomiting, cured by $\frac{1}{2}$ grain Morphine.—B.M.J. i./11,495.

Serum rashes and Serum sickness in diphtheria, *i.e.*, following the hypodermic injection of Diphtheria Antitoxin and other sera are said to be modified by simultaneous use of **Thyroid Gland**—up to five years $1\frac{1}{2}$ grains daily for six doses, from 10–15 years and upwards 5 grains on alternate days for 4 doses. Out of 100 cases 16 suffered Serum sickness who did not receive Thyroid, whilst only 6 suffered who received it.—L. i./11,373.

The symptoms of Diphtheria Serum Sickness are fever, rash, usually urticaria or a variety of erythema multiforme occurs in about 33% of cases treated, sometimes more unpleasant effects, namely, pains in joints, tendons and fasciæ with fever.

Infective endocarditis well treated by Antidiphtherial Serum.—B.M.J. i./10,14. Protective Inoculation in Diphtheria Epidemics.—M.P.C. ii./11,429

Profuse hæmorrhage in diphtheria.—A case of a boy aged five treated by several 4,000 units of Antitoxin by the mouth, in addition injections of 2,000 and 4,000 units. At the time during the case about $1\frac{1}{2}$ pints of blood were passed with membranous casts. One piece more than 2 ft. long. The *prima via* was clearly implicated and the topical use of the Antitoxins was successful.—W. F. Clark, B.M.J. ii./13,1484.

Dysentery.—There are two main types of dysentery—Amœbic and Bacillary (*c.f.* Vol. I., p. 513).

To search Stools and Mucus for Entamœba Histolytica.—

In *searching mucus* for *amœbæ* stain with a little Methylene Blue and examine with low power, *e.g.*, $\frac{1}{2}$ inch—turn on the $\frac{1}{8}$ inch to verify. *Amœba Coli* occurs very seldom.—L. ii./12,1064.

Alternatively,—place a small piece of freshly passed stool on a slide, adding one or two drops of 1 in 10,000 Neutral Red in Normal Saline. Examine with $\frac{1}{6}$ th inch objective. The Amœbæ take up the Neutral Red,—all other constituents of the fæces,—even the leucocytes—remaining uncoloured.—Sir C. P. Lukis, B.M.J. i./13, 1357.

Differential Diagnosis.—Characteristic cellular exudate in the stools of amœbic and in bacillary dysentery. The finding of *E. histolytica* in the midst of a “bacillary” exudate of this kind

indicates that a double infection is present, although attempts to isolate dysentery *bacilli* may fail.—J. G. Willmore and C. H. Shearman, L. ii./18,200. See also G. M. Findlay, L. i./19,135.

Notes on etiology of dysentery. *E. histolytica* in 63 cases out of 217 and *B. Dysentericæ* (Shiga) in 47.—C. J. Martin, B.M.J. i./17,479.

J. W. Cropper and R. W. H. Row describe methods of concentration of cysts from stools.

(1) **For Diagnosis.** Shake a lump of fæces (at least 1 Gm.) in about 30 Cc. of normal saline preferably with a mechanical shaker in a large flask or bottle for $\frac{1}{2}$ hour. Then transfer to a separating funnel and shake by hand for $\frac{1}{2}$ minute with 10 or 20% of its volume of ether. Allow to stand for a minute or two. The cysts remain in the saline, fæcal debris rising in a mass at the top of the saline, immediately below the excess of ether. The saline is removed and centrifugalised. The sediment in the centrifuge tubes would be some 15 times as rich in cysts as the original matter. If desired this can be again shaken up and centrifugalised afresh.

(2) **For Cultivation.** A modification of Penfold, Woodcock & Drew's process (B.M.J., May 20, '16) does not employ ether and is therefore more suited for cultivation purposes.

10 Gm. of specimen are shaken with 100 Cc. of saline in a mechanical shaker 5 minutes and poured onto fine silk of mesh 40μ . stretched on its tumbour. It is gently stirred with a rod and the filtrate or a portion of it is centrifugalised one minute at 1200 revolutions per minute, the supernatant liquor poured off and the volume made up again with normal saline. Shake and again centrifugalise. Repeat until the supernatant liquor is almost clear. Finally shake the deposit with 10 Cc. normal saline and allow to stand for 10 minutes. The upper portion is then poured off and thoroughly centrifugalised and loopfuls used for making hanging-drop preparations for cultivation. For counting Bottcher's slides are used.—L. i./17,179.

Characteristics of *E. histolytica*.

The entamæba varies in size from 6 to 35μ , though usually being $\frac{1}{2}$ to 3 times the diameter of a leucocyte, *i.e.* 12 to 24μ . Pigment is contained and it is supposed they take the red blood corpuscles as nutritive material. The organism can, according to Rogers, only be rarely found in pus, but is always present in scrapings from the wall of the abscess. The amœba passes through the intestinal wall and on reaching the submucous layer forms an abscess. Hewlett says the organism may be cultivated on ordinary agar if an organism, *e.g.* *B. Coli*, be present. For a description of this and other amœbæ see Medical Research Com., B.M.J. i./17,609; also H. A. Haig, L. ii./19,823; and J. S. White, P.J. i./15,797.

Comparison with *E. Coli*. The movements of *E. histolytica* are rapid and energetic while *E. Coli* moves slowly. In the granular endoplasm of *E. histolytica* red blood cells are almost always present—never seen in *E. Coli*. There are no vacuoles in *E. histolytica* but in *E. Coli*. The nucleus is eccentrically placed in *E. histolytica*, has ill-defined outline, a diameter of 4 to 6μ , is oval in shape, with little chromatin, has a vesicular nucleolus and is often partly hidden by the granular endoplasm. The nucleus of *E. Coli* is well defined, spherical, sharply differentiated from the granular endoplasm, contains much chromatin and has an indistinct nucleolus. The cysts of each are, however, difficult to distinguish.—Prof. V. Gabbi, L. i./16,523.

Entamæba Nana (Wenyon & O'Connor) inhabits the human intestines in addition to *E. Coli* and *E. Histolytica*. *E. Nana* is a small amœba measuring when rounded 6 to 12μ . The cysts are very resistant. No evidence that it is pathogenic.—C. Dobell & Margaret W. Jepps, B.M.J. i./17,607.

Lamblia Infections. Three cases in men who have never been out of England. Circumstances of infection not known.—A. Malins Smith & J. R. Matthews, B.M.J. ii./16,389.

These parasites are very troublesome to remove. The best results were obtained with Beta-Naphthol 15 grains and Bismuth Salicylate 20 grains thrice daily. Turpentine in 10 minim doses tried but not so useful.—B.M.J. ii./16,407.

Entamoeba Coli. *Syn.* *Amoeba Coli* of Losch. Occurs in the upper part of the large intestine. It appears to be harmless. According to Schaudin it differs from *E. histolytica* in that the ectoplasm is not distinctly seen except during the formation of a pseudopodium and the nucleus stains deeply. *E. Coli* multiplies by binary fission and also by multiple fission into 8 small amoebæ. *E. Histolytica* produces an indefinite number of small amoebæ.—J. S. White, P.J. i./15,797. For further differences see *E. Histolytica*.

Transmission of Intestinal Protozoa experiments. Amoebic Dysentery is possibly dust-borne. Stephens' Scarlet Ink used for staining purposes.—J. C. Watt, L. i./20,543.

Bacillus Dysenteriae. In previous Editions we gave numerous extracts and references to work on the bacteriology of dysentery. The position is, however, by no means clear, there has been, it appears, renaming of identical bacteria. The organisms are undoubtedly divisible into two main groups. According to a recent Medical Research Committee Report, *B. dysenteriae* (Shiga) and *B. dysenteriae* (Flexner), it is universally agreed cause bacillary dysentery—short rods, destitute of flagella, and non-motile, Gram negative, fermenting Glucose and sometimes other sugars and alcohols without gas formation.

Shiga's organism is relatively well defined. It does not ferment Mannite, does not produce Indol in Peptone Water. It is highly toxic to man and animals. It is a distinct and separate species. Neither group produce changes in Lactose or Saccharose.

Flexner's, however, is separable into several distinct strains Details.—F. W. Andrewes, F.R.S., and A. C. Inman, Serological Races of the Flexner Group, Med. Res. Com. Rep., Series No. 42. L. i./18,560 ; i./20,162.

American writers regard all the various strains as of equal etiological importance, while the Germans hold that the Shiga-Kruse Bacillus is the only true type.—Sir C. P. Lukis, B.M.J. i./13,1357. For further abstract of this paper see Vol. I., p. 512.

The bacilli of Shiga and Flexner are non-motile, non-sporing, and do not stain by Gram's method and grow on all ordinary media. In cultural characters they resemble *B. coli communis*.

The close relation of the prevalence of infantile diarrhoea mortality and the prevalence of flies is shown in a number of diagrams of plotted curves which are wonderfully coincident. Insect porters of bacterial infection.—C. J. Martin, L. i./13,181.

The two varieties of Shiga and Flexner certainly account for the dysentery of Japan, China, the Philippines and the West Indies. One or other occasionally appears in temperate countries. *B. Dysenteriae* is difficult to isolate.—B.M.J. i./09, 768.

DYSENTERY CARRIERS.—Healthy carriers are very rare and of no importance. Actual carriers are to be found among the incomplete convalescents which form a high percentage of the cases. In combating an epidemic it is necessary to reduce as far as possible the number of such cases and to isolate very strictly those that are already of this type.—B.M.J. ii./10,1507.

Isolation of pure dysentery toxin has been effected by Kirschbaum and Frankel by means of an ultrafilter, i.e., filter-paper that has been impregnated with Acetic Acid Collodion under pressure of six atmospheres. The toxin is a colloidal body kept back by the filter, it is poisonous and alkaline,—the filtrate is non-poisonous—its toxicity and immunising power is neutralised by acids, but restored again on adding alkali. The substance which has been separated from a broth culture of the Shiga-Kruse Bacillus is not

identical with nucleo-protein. The presence of Sulphur, Purin or Carbohydratē could not be demonstrated. One decigram sufficed to kill a rabbit—M.P.C. i./14,394.

A review of knowledge of dysentery.—F. M. Sandwith, L. ii./14,637,683,783.

Schmidt's Test in Summer Diarrhœa. This depends on determining the presence or absence of altered or unaltered bile in the fæces. A teaspoonful of fæcal material is placed in a wide test-tube, a little sterile water is added and well stirred with a glass rod. Four to six volumes of saturated aqueous corrosive sublimate solution are added, the whole shaken and allowed to stand 12 hours. Normally the colour will then be bright red. If unchanged bile pigments are present the colour becomes green. If no colour change occurs bile is absent and the reaction termed negative. In summer diarrhœa it is generally negative; with improvement a positive reaction occurs, *i.e.*, green or red colour produced. In an investigation by J. S. Pearson no case ended fatally in which the test continued positive or after treatment became positive.—L. i./15,144.

Spirochaeta Eurygyrata may occur in stools of dysenteric and apparently healthy persons. It has tapering ends, measures up to 15 μ by about 0.25 μ . The number of coils is variable.—H. B. Fantham, B.M.J. i./16,815.

Filariasis.—In *Filaria sanguinis hominis* infection or elephantiasis, there are two kinds, nocturnal and diurnal, which only appear in the blood immediately below the skin at night and day respectively, and the mosquitoes, in which the cycle of the parasite's existence is completed, only bite during these respective periods. An effective treatment, therefore, is to alter the patient's sleeping period—*e.g.*, by keeping him awake at night.—Cantlie. The parasite is acquired by drinking infected and polluted water. Larvæ only of *Filaria nocturna* occur in the blood. The worm itself is subcutaneous. Elephantiasis in all its phases is very marked in these localities. The worm is introduced under the skin in early stages by the proboscis of a type of *Culex*. Several species of mosquitoes may however subserve.

The female adult worm was discovered by Bancroft, the male by Arango, and the embryo by Demarquay and Lewis. The embryos inhabit the lymph channels of the lower extremities and the scrotum. They lead to dilatation of the lymphatics, to hyperplasia of the tissues, chyluria, hæmaturia, abscesses. &c. They are found in the blood at night.—Gould.

Eosinophilia in filarial disease. The eosinophile cells accumulate round the encapsuled fluke.—L. i./06,1623.

Prospective cure for elephantiasis by introducing silk threads into the limbs to replace the trunk lymphatics, and remove the oedema.—L. i./09,31.

Filariasis Discussion opened by G. C. Low.—B.M.J. ii./13,1299.

Filariasis (*F. bancrofti* infection) with plenty of embryos present in the night blood treated with Antimony Tartrate intravenously—no effect (contrary to Rogers).—G. C. Low and A. L. Gregg, L. ii./20,551.

Sir P. Manson has a very thorough Chapter on Filariasis in his "Tropical Medicine." The nomenclature of the parasites has undergone great revision. The filarial periodicity and the anomalous non-periodic types are dealt with.

Gas Gangrene.

Gas Gangrene is caused by *B. Aerogenes Capsulatus*—the Bacillus of Welch, —often in association with other organisms.

Bacteriology.—Sir A. E. Wright with his co-workers investigated the conditions of growth of this organism both in artificial media in the blood fluid *in vitro* and in the dead and living organisms. The results led to the conclusion that the growth of the bacillus does not necessarily turn on the presence or absence of oxygen, but rather that it depends on a mechanical factor which appears to be, so far as the test-tube experiments are concerned, the presence of some hole or cranny to serve as a nidus in which the microbe can concentrate its chemical effort at first upon a fractional portion of the culture medium. Clinically the supervention of gangrene is very frequently correlated with leaving infected pieces of clothing in wounds.

The toxæmia of gas gangrene is an acidæmia. The production of acid proceeds probably not only in the infected parts but also in the liver and other internal organs. Sodium Lactate 20 Gm. injected effected rapid cure and 10 Gm. of Sodium Bicarbonate intravenously improved with ultimate recovery.—L. i./17,1, and B.M.J. i./17,53.

The progress of gas gangrene is too rapid to allow of any curative vaccine treatment but temporary increase in immunity might be effected by a vaccine

of the organism and the streptococcus, sufficient to prevent spread of infection into the tissues. Large doses of *B. Aerogenes Capsulatus* (up to 1,000,000,000) can be injected without reaction.—A. Fleming, L. ii./15,376,640.

Emphysematous Gangrene. A useful account of experience gained in first six months in the war. Incisions and free syringing with H_2O_2 advised.—J. B. Haycraft, L. i./15,592.

Hydrogen Peroxide B.P. strength made neutral or slightly alkaline with Sodium Bicarbonate injected into infected wounds around the infected area saved limb.—A. A. Martin, B.M.J. i./15,145, but the procedure has been followed by death from gas embolism. Local use of Hydrogen Peroxide and Iodine Tincture recommended.—B.M.J. i./17,465.

The anærobic organism causes an inflammation characterised by great swelling and copious sanious discharge full of bubbles or gas. The action of the organism is greatly assisted by the presence of staphylococci or other bacteria. The activity of the organism is enormous. Effect produced within 5 hours of a wound. Sir Anthony Bowlby says he has seen a whole limb gangrenous in 10 hours and the patient dead within 16 hours. Effects of Dakin's and Lorraine Smith's Hypochlorous solutions respectively equally good.—B.M.J. ii./15,913.

Self-inoculated *B. Aerogenes Capsulatus* treated with 25 Cc. of 1½% **Quinine Hydrochloride Solution** injected intramuscularly; 10 hours afterwards 30 Cc. Within 24 hours marked local effects were produced. At the end of 48 hours patient recovered and temperature reached normal.—K. Taylor L. ii./15,977; i./17,294,306.

B. aerogenes capsulatus, *B. œdematis maligni* and *B. tetani* isolated from gangrenous wounds. Morphology. Staining reactions.—H. R. Dean and T. B. Monat, B.M.J. i./16,77.

The gas gangrene organism is a normal inhabitant of the intestines of adults and sometimes in small numbers in the stools of infants. If in excessive numbers and if the diet contains an undue amount of fermentable carbohydrate diarrhoea is likely to result. Give a diet rich in protein instead of one rich in carbohydrate.—J. P. Symonds, Rockefeller Inst. Monograph, Sept. 27, '15 B.M.J. i./16,102.

Factors responsible for gas gangrene. The endotoxin contained, the exotoxin produced, the tissue toxin elaborated from the tissues and gas produced are considered. The pressure produced in the tissues by the growing organisms is most destructive—this mechanical action is the most important part of the infection.—K. Taylor, L. i./16,123.

Infection of wounds by gas producing organisms—either that of malignant œdema or by *B. aerogenes*.—A. Mackenzie Forbes, B.M.J. i./16,369.

Natural history of septic wounds—an exhaustive paper. Preponderance of anaerobic organisms: *B. œdem. malig.*, *B. perfringens* and *B. Hibler*. Small incidence of *B. tetani*. The wounded tissues contain anaerobes months after the original injury. The activity of the anaerobes depends to a great extent on their symbiosis with aerobes. Vaccine therapy important and urgent in prevention of "flares" after operation and in prevention of sinus formation and secondary hæmorrhage.—Sir K. Goadby, L. ii./16,89. A mild vaccine of sensitized polyvalent *Streptococcus* 5, with *B. proteus* 10 million, to be given pending bacteriological report. In case of gas gangrene *Strepto.* vaccine combined with *B. proteus* and *B. lactis aerogenes* to be given—10 million each, repeated on the third day.—Special Section, Vaccine Therapy, Sir K. Goadby, *ibid.* 585.

Gas Gangrene as seen at casualty clearing stations. The disease was the bugbear of the surgeon at the front. There is no wound one can feel happy about if not opened up. Some remedy other than surgery longed for.—C. Wallace, B.M.J. ii./16,381.

A polymicrobial invasion of aerobes and anaerobes. No single organism is specific. At one time it may be *P. perfringens* or at another the *Vibrio Septique*, Vincent's organism, *B. Coli* and others. A syndicate of bacteria causes the trouble. Some cases show gangrene without gas formation and give gas without gangrene. As to the incubation grave forms start 24 to 48 hours after the wound, while slow forms begin on the fourth day. Alum compresses, also saturated ether solutions of camphor advocated—Ferrie Chloride, Quinine Hydrochloride, Ether, Camphor and other substances also gave good results.—Fr. Guérmonprez, B.M.J. ii./16,663.

B. Perfringens practically always present in discharges and tissues of all wounds in the war and being also present in the soil-stained clothing its access to wounds is easily understood. In the early stages of infection there is usually nothing to indicate the gravity of the condition, but in 2 to 5 days slight swelling develops and presence of gas in the tissues can be detected. Copper coloured mottling of the skin occurs adjacent to the wound with foetid odour. Hypochlorite washing with aid of fenestrated tube described and advised. Wright's Saline treatment may be successful in selected cases but the majority of progressive cases require surgical treatment.—Fauntleroy B.M.J.E.i./16,24.

Colour changes in skin and muscle in gas gangrene.—C. Wallace, B.M.J. i./17,725.

The method of spread of gas gangrene into living muscle.—J. W. McNee and J. Shaw Dunn, *ibid.* 727.

B. Welchii, though usually considered an anaerobe, will grow freely in open narrow tubes. It grows vigorously in liquid medium when Nitrogen containing 1% Oxygen is bubbled continuously through the tubes, but it is inhibited by higher proportions of oxygen.—C. G. L. Wolf, C. M. McGill and J. E. G. Harris, L. ii./17,787.

B. Multifermentans tenalbus isolated from a case.—J. L. Stoddard, L. i./19,12.

B. tumefaciens, a new pathogenic anaerobe from.—W. J. Wilson, L. i./19, 657.

Amputation may be the only remedy.—L. Menciére, L. i./15,270. *See also* Eusol, Vol. I., p. 54; Quinine Hydrochloride, Vol. I., p. 667; and Specificity in Antiseptics, Vol. II., p. 348.

Glanders.

Mallein.—A growth of the glanders bacillus in glycerinated broth. corresponding exactly in mode of preparation to Koch's original tuberculin. This vaccine is used as a test for the presence of glanders in sick horses, and has been injected for the cure of chronic glanders in man. The Mallein of the Lister Inst. for animals is injected in dose of 1 Cc. for diagnostic use subcutaneously in the neck over vertebræ about midway between jaw and shoulder, complete reaction is a rise in temperature of 2.7° F. after 12 to 20 hours and an extensive hot and painful local swelling.

Should the rise in temperature not exceed 1.0° C. or 1.8° F. or the size of the swelling not exceed 3 inches in diameter in 24 hours, the freedom of the animal from glanders is highly probable.

The temperature reaction is unreliable in all cases in which the temperature at time of inoculation is 2.5° F. above normal. In such cases, if there are any suspicious clinical signs to assist, reliance may be placed on the occurrence of the local swelling.

Human Glanders. Mallein satisfactorily employed in dose of 10 to 15 minims,—difficulty of diagnosis owing to close resemblance between the ulceration and the tertiary syphilitic ulceration of the buccal and pharyngeal cavities.—B.M.J. i./09,319.

A case with death.—L. ii./20,941.

Gonorrhœa.

RECOGNITION:

The *Micrococcus Gonorrhœæ* is a medium sized diplococcus; reniform in shape, in groups, intracellular character. This point is thought to be of no value in differential diagnosis, though previously stated to be so (*vide later*). The organism is Gram negative.

Cultivation.

Comparative Tests (under the Medical Research Committee) showed that (1) Thomson's Human Plasma-Glucose Agar (2) Coles' Tryptic Blood Agar, (3) Gordon & Hine's Trypsinised Pea Extract Agar were satisfactory for cultivation. The last is for the meningococcus (*q.v.*) and if made of reaction +6 (Eyre's Scale) instead of +1 it would be improved for the gonococcus.

Human Plasma-Glucose Agar.

To nutrient agar (2.5%) made in the ordinary way with bouillon and Witte's peptone (1%), rendered +6 acid add the salts neutral to the human blood (as in Ringer's solution)—namely: Sodium chloride 9 Gm., calcium

chloride 0.25 Gm. and potassium chloride 0.42 Gm. per litre. Add also glucose 2.5%. (This addition in some manner renders the growth much more profuse.) Then tube the medium, about 4 Cc. being added to each test-tube. The sterile tubed agar is melted in boiling water, and after cooling to about 50° C. add 1 Cc. of human plasma to each tube and mix thoroughly by rolling the tube between the palms. Solidify the medium in a sloping position; the medium is perfectly transparent. For plating, the contents of three tubes may be added to a Petri dish.

To obtain Human Plasma.—Blood is frequently drawn off from the veins of syphilitic patients (it is immaterial whether the patient is being treated or not with arsenic or mercury) in hospital for the Wassermann test.

When required draw off three-quarters of a test-tube-full of blood with sterile precautions. Fill a sterile centrifugal tube, containing 2 Cc. of 2% sodium citrate solution, with the freshly drawn blood. Plug with a sterile cork (keep the corks in alcohol and burn off the alcohol before plugging) and centrifugalise. Pipette off the serum with a sterile 10 Cc. pipette and add 1 Cc. to each tube of agar as stated. (If the test-tube of blood is three-quarters full there is sufficient left for the Wassermann test.)

Using this medium the growth is profuse even in 18 hours.—D. Thomson B.M.J. i./17,869.

For *Cole & Onslow's Tryptic Broth (& Agar)*, see *B. Typhosus*, p. 550. *Milk Serum (Sabouraud & Noire)*—A culture medium to replace the use of Ascitic fluid—as in *Nasagar Medium*, see Abel and Gordon—*Bacteriology*, p. 147—which is both difficult to obtain and sterilise.

(1) A litre of fresh milk is boiled for five minutes; (2) the Casein is then precipitated with 2 Cc. of Hydrochloric Acid, and the Serum recovered by simple passage through a piece of linen; (3) the filtrate is then added to half its quantity of water and the mixture neutralised with 10% Soda Solution; (4) it is then autoclaved at 120° for ten minutes; (5) the following are then added in the strength indicated: Peptone 1 in 100, Glucose 1 in 100, Urea 0.3 in 100, Agar 1.6 in 100; (6) filtration and division into separate test-tubes, which are sterilised for ten minutes at 110° C., completes the preparation.—B.M.J.E. ii./13,44.

Isolation of gonococci may be effected from the fluid of gonococcal arthritic joints. It is not easy to obtain the gonococcus from the blood; although cultures are often obtained therefrom; when urethritis has ceased and fluids have disappeared from the joints, one proceeds by drawing 2 Cc. of the blood, with aseptic precaution, from the median basilic vein, and mixing with double the quantity of Agar Agar and plating immediately.—W. Murrell, Pr. Jan. 12, p. 35.

Milk Broth or Milk Agar.

Fresh milk 1,000 Cc. is mixed with 5 Cc. of 1 in 4 Hydrochloric Acid and kept at 37° C. for 16 to 20 hours to precipitate Casein, or the milk can be boiled, filtered and the filtrate neutralised with 10% Sodium Hydrate—then place in autoclave 2 hours, boil, neutralise again and filter. The filtrate is mixed with equal parts of broth, or one or two parts of 'Agar.' Put into test tubes and sterilise.—J. E. R. McDonagh, Pr., Nov./10.

¹²² **Diagnosis of Gonococcal Infections** (from Med. Res. Com. Rep. No. 19, 1918; see also B.M.J. ii./18,317).

Films made from discharge in a frank case of acute gonorrhœa are characteristic as regards the intracellular position of the gonococci but diagnosis can *not* be based on presence or absence of intracellular diplococci. For official purposes **Gram's method** of staining must be used.

In decolorising, *Absolute Alcohol* must be used, *i.e.* 98% or over. *Weak Alcohol* decolorises Gram positive organisms. It should not be used for more than 2 minutes.

W. Jensen of Copenhagen discards the use of Aniline Water, (2) increases the strength of the Iodine solution, and (3) counter-stains with Neutral Red.

After making the film in the ordinary way, fixing and *cooling*—

Stain with 0.5% Aqueous Methyl Violet (6B) $\frac{1}{4}$ to $\frac{1}{2}$ minute.

Pour off the bulk of the stain and wash away the remainder with a drop or two of *strong* Lugol's Solution (Iodine 1, Potassium Iodide 2, Water 100). Do not wash off with water.

Pour on a fresh quantity of the Lugol and leave $\frac{1}{2}$ to 1 minute.

Wash with *Absolute Alcohol* and pour on a fresh quantity of it moving the slide from side to side as in developing a photo plate. (A third washing may be necessary to complete decolorisation).

Finally rinse with a few drops of Alcohol and without washing in water stain with

Neutral Red Solution. Neutral Red 1 Gm., 1% Acetic Acid 2 Cc., Distilled Water 1000 Cc. (made stronger if necessary), for 15 seconds to 1 minute.

Wash in water, dry and mount.

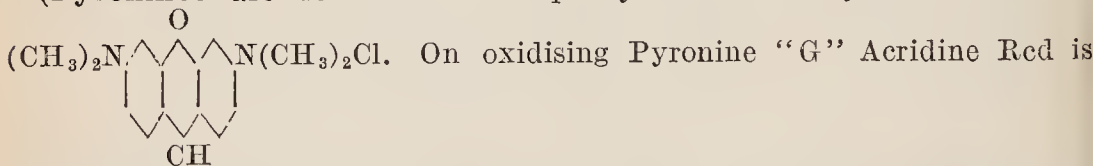
The gonococci take up the red dye. (Good coloured plates are given in the report.)

Pyronin Stain, Syn. Pappenheim's or Unna's Stain.—Concentrated Aqueous Pyronin Solution 1, Concentrated Methyl Green Solution 3, is useful. Stain 5 minutes, wash and dry. Gonococci stain red, cells, etc., blue.

Wyatt Wingrave's Modification = Pyronin (water soluble) 2, Methyl Green 3, Distilled Water 100. Dissolve separately, mix and filter. After staining, wash with water and differentiate with 5% Resorcin in Alcohol.

All organisms by this method especially the Gonococci, stain a brilliant red and pus cells greenish-blue. The Gonococci are found in regular clumps of Diplococci, the distance between each pair being much the same. Some are intracellular.

(**Pyronines** are derivatives of diphenylmethane. Pyronine "G" is



obtained.)

The diplococcus can usually be readily found in large numbers in discharges of gonorrhœal origin, but a diplococcus of similar appearance is also apparently to be found not infrequently in vaginal discharge of non-gonococcal origin. If a distinction is to be made it is best to try to grow the organism in question on the ordinary forms of culture media, as, while the gonococcus will not grow on plain agar, it grows freely on blood agar. On the other hand, the other forms of diplococcus met with in the vagina usually grow freely on plain agar. It is also possible that the presence of the diplococcus inside the pus cell is characteristic of the gonococcus, but one must be a trained microscopist, who is continually examining such preparations, to be certain that what appears to be inside the cell is not really lying directly below or above it. Therefore, in cases in which a diagnosis is of serious importance, it should never be based on a mere clinical examination.—J. E. R. McDonagh, Pr. Nov. '10.

Acid Thionin.—Thionin 0.5%, Glacial Acetic Acid 5% in Distilled Water. Stain 3 minutes, wash in tap water. A very reliable stain,—shows phagocytosis well and the characteristic "kidney" shape of the Cocci. Best stain for general use when confirmed by 'Gram.'—Wyatt Wingrave.

(Thionin $\text{C}_{12}\text{H}_9\text{N}_3\text{S}$ can be made from para-phenylenediamine by oxidation in the presence of H_2S .)

Jenner's Stain, q.v., also gives excellent results.

Nissl's Stain.—Methylene Blue, 'B. Patent,' 3.75, Soft Soap 1.75, Water 1,000. Stain thin smears (fixed in air) without heating, for 1 minute, wash, blot and examine.

Other Diplococci:—*D. albicans amplius* Bumm, found in mucus in the healthy vagina; *D. albicans tardissimus* morph. identical with the *Gonococcus*; *D. Coryzæ*, *D. intracellularis Meningitidis* (v. Cerebro-spinal Fever), *D. of orchitis* found in gonorrhœal pus during the first two days—pathogenic), *D. pneumoniæ*, syn. *pneumococcus* of Frankel, q.v., *D. pyogenes ureæ*, and *D. Catarrhalis*, vide *M. Catarrhalis*.

N.B.—*Pneumococcus* is the only Gram + Diplococcus. Capsule well marked in pus, but not in culture. Cocci, elongated or lanceolate, converts oxy- into methæmoglobin in the culture. Will not grow on Gelatin.

Complement Fixation.

The test indicates presence of the disease long after disappearance of the gonococci. Antigen made by dissolving the gonococci in alkali and then rendering neutral. The gonococcus protoplasm as already stated is soluble

in alkali: so also is the meningococcus but a strain of micrococcus catarrhalis was not soluble. This might be a useful means of distinguishing between these three allied species.—D. Thomson, L. ii./18,42. See also H. B. F. Dixon and A. H. Priestley, L. ii./19,964.

Vaccine Therapy.—See Vol. I.

The following is a recent note:—

Chronic gonorrhoeal rheumatism treated by vaccines intravenously—protection greater and almost immediate. Largest dose of Gonococci used was 2000 million.—A. R. Fraser and A. G. B. Duncan, L. i./20,248.

Guinea Worm. DRACUNCULUS MEDINENSIS, *Syn. D. Persarum, Filaria Dracunculus, F. Medinensis.*

Found in parts of India (Deccan, Scinde, etc.) in Tropical Africa, Persian Turkestan, Arabia, especially on West Coast of Africa. In parts of the latter nearly every negro has one or more specimens about him. The size of the female parasite is about $1\frac{1}{2}$ mm. by 90 cm. as average. Little definite is known of the male. Habitat of the female is the connective tissue of the limbs and trunk. It has been thought the infection of man occurs by ingestion of infected cyclops as 0.2% Hydrochloric Acid arouses the larvæ in an infected crustacean while the latter are killed. Evidence is fairly complete as to this mode of infection, but it must not be supposed that every species of cyclops can act as intermediary host. As to treatment, Emily, a French naval surgeon, has succeeded in killing the parasite by injecting Mercuric Chloride solution 1 in 1000 into the body of the worm.—Sir P. Manson Tropical Diseases, 1919.

Guinea-worm treated with N.A.B. Dose 0.15 Gm. in 20 Cc. Distilled Water.—C. G. Grey, L. ii./20,100.

Antimony Tartrate for guinea worm intravenously.—J. W. S. Macfie, L. i./20,654. Hyd. Perchlor. injections tried subcutaneously into the protruding head.—J. Graham Forbes, L. i./20,837.

Hog Cholera—*B. Suipestifer* (or *Bacillus Ærtryck*) was isolated from cases of hog cholera, although this may really be due to a filterable virus. It has been found in the intestine of normal pigs, and may originate meat poisoning, especially where pork is the substance at fault. It shows close resemblance to *B. para-typhosus* "B" and to demonstrate it the method of absorption or complement fixation must be employed.—M. & R., 7th Edn

Bacillus Influenzæ, *Syn. Pfeiffer's Bacillus.* A very small bacillus non-motile. Does not stain by Gram's method, nor grow on ordinary media unless albumen be present.

Cultivation.

B. Influenzæ grows best on a moist Hæmoglobin Agar containing no Glucose—in many respects opposite to the gonococcus in cultivation requirements.—D. Thomson, L. i./19,1106.

Blood Agar made by boiling the agar medium with blood for a minute and separating the coagulated protein is a good medium for growing *B. Influenzæ*. Or Blood 1 Cc. may be diluted with 9 Cc. of water and boiled. The clear liquid added to Nutrient Agar is also an excellent medium for the organism, or strong mineral acids, *e.g.* Sulphuric, may be used without heat to act upon blood and the liquid subsequently neutralised with Soda.—A. Fleming, L. ii./19,138.

Blood digested by Trypsin as medium for growing Influenza B.—J. Matthews L. ii./18,104.

The pneumococcus occurs very frequently in conjunction with the influenza bacillus. A mixed flora in the secretions in these cases is characteristic. Influenza bacilli are commonly found in the throat in pertussis, measles, and pulmonary tuberculosis. *c.f. Vol. I., 865.*

The Influenza Bacillus is thought to be only one of a group, the members of which have similar, if not identical, morphological and cultural characteristics but different pathogenic properties. In epidemic influenza Pfeiffer's organism is rarely found in the blood except as an agonal phenomenon. Nevertheless, in certain cases of endocarditis and of septicæmia an organism identical in all respects with *B. influenzae* can be isolated, and is in all probability the cause of the illness. Organisms hitherto described as *B. influenzae* are not all identical with it, but like the Strepto, Staphylo and Coli-typhoid family, belong to a group, the various members of which possess very different pathogenic powers.—H. Thursfield, Q. Jl. Med., Oct. '10, p. 1.

Vaccine Theraphy is fully dealt with in Vol. I., p. 864 et seq. Note, however, the following:—

War Office Conference Vaccine has been revised to the following formula:—

B. Influenzæ	::	::	::	400 millions	} in 1 Cc.
Streptococci	::	::	::	80 „	
Pneumococci	::	::	::	200 „	

With the increase in proportion of the first mentioned, the vaccine may prove a powerful reinforcement to measures of protection. Dose $\frac{1}{2}$ Cc. with a further 1 Cc. after 10 days' interval. Table of results over wide area.—Sir W. B. Leishman, L. i./20,366.

Pfeiffer's organism causal of influenza in certain troops but not in others.—J. W. Edington, L. ii./20,340.

Periodicity of Influenza. Evidence pointing to the existence in this country of a minor cycle of 33 weeks and in addition a major cycle round about 10 years maxima.—J. Brownlee, L. ii./19,856; C. O. Stallybras, L. i./20,372; see also B. E. Spear, *ibid*, 589.

Influenzal pneumonia. Hydrogen Peroxide transfusion 2 ozs. of "10 vol." in 8 ozs. of Normal Saline. Gas embolism is not produced. Anoxæmia often markedly benefitted. Toxæmia overcome in many cases.—T. H. Oliver & D. V. Murphy, L. i./20,462.

Johne's Disease in cattle (previously thought to be due to coccidia has been identified with Johne's Bacillus—which is distinct from Tubercle Bacillus. F. W. Twort has grown the organism on the special culture medium used by him for isolating Leprosy Bacillus, *q.v.* Injections in guinea-pigs, rabbits, etc., produced negative results. Vaccines for the diagnosis of Johne's disease in cattle as distinct from tuberculosis may possibly be made. Communication to Royal Society of Medicine, Nov. 1, 1910; Na. Nov. 24/10,127.

Leishmaniasis. Under this term at least three diseases of man are included, viz.:—Kala azar, Oriental sore and espundia. Though clinically quite distinct, they are all associated with what optically appears to be the same organism, *Leishmania*. The *Leishmania* form is common to many protozoa—it is merely a stage—an immature stage of a flagellated parasite. The life history has as yet to be worked out.

Kala Azar. *Syn.* **Tropical splenomegaly, Dum-Dum Fever, or Black Fever, Ponos.** *L. donovani* present in spleen, liver and other organs.

Oriental Sore. *Syn.* **Tropical Sore. Delhi Boil.** A specific ulcerating granuloma of the skin caused by a species of *Leishmania*.

L.Americana, Syn. Espundia, bubas braziliiana, etc., occurring in Brazil, Bolivia, etc.—commencing with a sore on some cutaneous or mucous surface.

The oval "Leishman-Donovan" bodies are present in every case of Kala-Azar and are the cause of this deadly disease which is by no means confined to India. Sir L. Rogers in 1904 found that if kept in a sodium citrate solution at about 22° C. these bodies undergo multiplication, showing that they are capable of living outside the human body in some cold blooded animal, possibly an insect, but the life history remains to be completed. Similar parasites have been found in Oriental Sore and more recently in a variety of other ulcerative affections in tropical America and in the Sudan one of them—espundia being a very grave disease.—Sir Patrick Manson, B.M.J. ii./17,105.

A. Laveran has issued a treatise showing the relationship between forms of Leishmaniasis—(a) visceral, (b) cutaneous. The former comprises (1) Kala-azar proper; (2) Infantile Kala-azar; and (3) Canine Kala azar. The latter (4) oriental sore in man, (5) the mucosal form in America, and (6) orientalsore in dogs. The parasites in all these forms are indistinguishable. If identical then the relationship forms a tangle so far unravelled.—L. i./18, 24. See also B.M.J. i./18,176.

Leishman-Donovan bodies belong to a group of parasites which used to be classed together as *Herpetomonidæ*. They may be round, oval or pyriform, measuring 2 to 3.5 μ increasing to 4 or 7 μ in the flagellate form, by 1.5 to 2 μ with a granular cytoplasm containing two chromatin masses. The larger, more rounded, stains slightly, the smaller rod-shaped stains deeply. From the latter a linear structure runs to the acute end. A vacuole is often present. They are found in large numbers in the liver, spleen, bone marrow, lymphatic glands and mucosa of the intestines, in the blood of the

femoral portal or hepatic veins, more rarely in the circulating blood shortly before death. They cause the disease kala-azar and are probably spread by insects, but the particular carriers are not known.—A. Castellani and A. J. Chalmers, *Manual of Tropical Medicine*, 2nd Edition, p. 348. See also *Kala Azar and Tropical Sore*, W. B. Leishman.—*Ql. Jl. Med.*, Oct. 1911, 109.

In addition to the irregular fever there is progressive enlargement of the spleen, progressive wasting, swelling of feet and legs, diarrhoea simulating dysentery, and enlargement of the liver. Almost always fatal.—*I.M.G.*, Jan., 1907.

Good results have been obtained by injecting 20 to 90 minims of a solution made of Quinine Sulphate 32 grains, Dilute Sulphuric Acid 1 drachm, Distilled Water 4 drachms. Five minims of 2% Cocaine Solution is first injected; the needle is left inserted, the syringe withdrawn from it, the solution drawn up into it and injected after a couple of minutes into exactly the same place where the cocaine solution was injected. A certain amount of painless effusion is caused. Injections have to be repeated just before the effusion from the first injection has disappeared.—*Pres.* June, 1911.

According to Franchini in Italy at least it appears probable that the Leishman parasites are transmitted by anopheles. Further experiments on animals required to substantiate.—*L. ii./12,249.*

Kala azar in soldiers returning from Malta. Spleen puncture will show evidence of large numbers of typical parasites. Diagnostic methods—diarrhoea and splenomegaly. The latter is not so marked in enteric as in kala azar and is not so solid to the feel.—*G. R. Ward*, *L. ii./16,16.*

Kala-Azar in Mesopotamia, discussion as to.—*J. C. G. Ledingham*, *B.M.J. ii./19,88,667* see also *G. C. Low*, *ibid.* 758.

X-rays in oriental sore.—*L. ii./20,893.*

Leprosy.

The presence of *B. leprae* (**Hansen's Bacillus**).—The specific organism of Leprosy in the mosquito (*Culex pungens*) and in the bed bug (*Cimex lectularia*) was shown.—*L. i./06,1347.*

Bacteriology and pathological anatomy of leprosy. Possible association of leprosy with other diseases, *e.g.*, tuberculosis in the same individual at the same time.—*J. M. H. McLeod*.—*L. ii./09,515.*

From three cases of nodular leprosy an acid-fast bacillus isolated which by subculture through successive generations gave a pure growth possessing "certain peculiar characteristics resembling morphologically the bacillus of leprosy." The culture medium consisted of 250 Cc. of distilled volatile alkali of rotten fish, 250 Cc. of weak "Lemco" broth without salt or peptone, and 50 Cc. of milk. "After three days inoculation the culture of acid-fast bacteria was subcultured on nutrient agar and broth (without salt or peptone); a feebly acid-fast bacillus developed. Its acid-fastness was increased by growing in milk, the degree varying according to the fatty nature of the medium. Agar plate cultures were made and these, three days after inoculation showed discrete colonies about the size of a pin's head, opaque, orange-red, raised in the centre, humped and moist to the naked eye. After 48 hours' growth its appearance is as in the nodules of a leper. The cultures when tested on guinea pigs, white rats and rabbits, gave negative results. A monkey, after repeated injections with culture, developed clinical signs of the disease, and showed nodules in which were found typical leprosy bacilli, but attempts to obtain a pure culture from the lesions proved unsuccessful. Ten cases of leprosy were tested with Vaccines prepared from these cultures, "two have now recovered; two are so much improved that apparently the remnants of the disease are very slight, and the remaining six have all improved in a remarkable manner."—*E. R. Rost*, *I.M.S.* — *B.M.J. i./11,184.*

Captain Williams has grown from cases of leprosy **four types of organisms** which are thought to be four phases of pleomorphic streptothrix,—an *acid-fast* and a *non-acid-fast bacillus* and an *acid-fast and non-acid-fast streptothrix*. It seems that the acid-fast streptothrix form can be converted into a non-acid-fast bacillus by change in the cultural environments. The four different types may be regarded as four different phases of the *same micro-organism*. He further describes a Vaccine prepared from cultures of the Acid-fast Streptothrix for which he claims immunising and possibly curative properties.—*B.M.J. ii./11,184*; *L. ii./11,109*; see also *B.M.J. i./12,300,392* *L. i./12,741.*

Leprosy is possibly conveyed by the bed bug, but the 'fish hypothesis' is supported by Sir J. Hutchinson. The disease does not spread in the neighbourhood of leper establishments.—B.M.J. ii./11,463.

Some interesting experiments to determine mode of transmission of leprosy show that flies, mosquitoes and other insects may spread it but in particular *Acanthia lectularia* appears to constitute a very important agent in the spread. Acid-fast bacilli resembling *B. leprae* have been found in 30% of specimens up to 16 days after feeding on lepers.—T. Lindsay Sandes.—B.M.J. ii./11,469.

Bed bugs obtained from huts which had never been inhabited by lepers were caused to bite lepers near leprosy nodules on the face,—in every case they contained the bacilli. Experiments to determine how long they remain in the bug's body, etc., in progress.—E. C. Long.—B.M.J. ii./11,470.

Love of the leper for fish diet generally in a state of decomposition.—B.M.J. i./11,1234.

Leprosy can under certain circumstances be transmitted to animals.—B.M.J. i./12,424.

A thorough disinfection of the nose is one of the first essentials in treatment. A solution of **Ammonium Persulphate** 3.7% and Hydrochloric Acid 1% in water has been used. Inhalation of the fumes of **burning sulphur** has also been employed.

Benzoyl Chloride in Petroleum Oil is valuable as a nasal spray or paint to ulcerating surfaces—its regular use for such purposes is strongly advised. Further on Nastin.—L. i./13,335.

Leprosy and Goats.—Apparent connection between. Leprosy is held to be not transmitted direct from man to man. The goat is suspected to be the intermediary. As goats have gone out of "cultivation" with the increase of cattle and sheep, leprosy has diminished. Two types of tuberculosis have been found in the goat, one identical with bovine and the other totally different, producing internal nodules resembling those found in lepers. Tuberculin prepared from infected goats would probably have remedial value for lepers.—B.M.J. i./13,253; P.J. i./13,308; c.f., also Vol. I., p. 575, and Vol. II., p. 536.

A cultural extract of the organism made on lines of Tuberculin Oil has given good results at Charing Cross Hospital in early macular cases, but it is not of real advantage in advanced nodular cases.—H. Bayon, L. ii./13, 1529.

The Wasserman Test for leprosy is non-specific. In spite of much advance there is not a single cure of confirmed leprosy to the credit of modern science.—C. M. O'Brien, L. ii./15,529.

Bacillus Lepræ has morphology similar to *B. tuberculosis*, but usually occurs more in clumps and are said to be tapered at the ends. Stain irregularly, and are more readily decolourised than *B. tuberculosis* by inorganic acids Gram +.

NOTES ON ISOLATION AND CULTURE.—Leprosy material from a typical leper was placed in 2% Ericolin Solution to kill contaminating micro-organisms and then inoculated on the following tubercle medium:—Egg 3 parts, 0.8% Sodium Chloride 1 part, ground Tubercle Bacilli 1% and Glycerin 5% or less, mixed, placed in tubes, sterilised and set in slopes. On this the *Lepra Bacillus* grew very slowly as a delicate colourless streak along the inoculated track and showed the typical morphological and staining characters of the *Lepra Bacillus*; the *Bacillus* could be subcultured only on the Tubercle Medium.—F. W. Twort, P.R.S.M. Nov. 1, 1910; B.M.J. ii./10,1919; Na. Nov. 24/10,127.

A general review of the drugs used in leprosy. Chaulmoogra Oil affects the disease favourably, but it is not a cure. "X" Rays useful, but they have their limitations. Clegg working independently at Manilla has succeeded in cultivating an acid-fast bacillus from the spleen and nodules on the ear of leper patients. He prepared a Vaccine, also a Glycerin Extract and Soap Solution. Treatment by these means was tried upon a number of lepers during a period of over 12 months, but in no case with any perceptible benefit. The Glycerin Extract had no action on the skin of leprosy or normal persons. A remedy for leprosy is still wanted.—L. i./11,1523, c.f. F. W. Twort's work, above.

It is possible that the Hansen's bacillus is merely a harmless accompaniment of the real organism. It is possible to cultivate from cases of human leprosy a diphtheroid organism which acquires acid-fast properties on being injected into rats or mice.

Besides the culture of an acid-fast or other organism, complete animal experiments and extensive serological tests are necessary before a statement as to its relationship to the disease can be made. Mice or rats injected with a culture of acid-fast diphtheroid bacilli originally obtained from acid resisting diphtheroid organisms of human leprosy, are capable of giving a culture of an acid-fast rod-shaped bacterium which when injected into other rats gives rise to what appears analogous to genuine spontaneous rat leprosy. The most favourable medium for growth appears to be either Placental-Extract-Agar or Horse Serum Nutrose-Agar with the addition of 2% ground-up *Smegma Bacilli*. The author confirms *Kedrowsky's* work on the variable morphology and staining properties of the *Lepra Bacillus*. Agglutination, precipitation, complement—deviation and percutaneous tests can be used to prove the relationship of acid-fast or other germs cultured from cases of leprosy. Rat and human leprosy appear to be identical diseases. It is therefore possible that the germ of both can be transmitted from one to the other given an appropriate intermediary.—Bayon, B.M.J. ii./11,1269; L. ii./11,460.

The organisms isolated from the lesion of human leprosy.—C. Duval, B.M.J. ii./12,1189. Problem of leprosy, M. E. Marchoux, *ibid.* 1191. Study of various cultures of *B. Lepræ*.—H. Bayon, *ibid.* 1191. See also L. ii./12,1791.

Bed bugs and leprosy. Preliminary note. The results of examination of bed bugs fed experimentally on nodules of lepers at the Royal Southern Hospital, Liverpool, as also examination of bed bugs fed on lepers in Panama were entirely negative.—David Thomson, B.M.J. ii./13,849.

Kedrowsky claimed to have cultivated the leprosy bacillus. Examination of his organism showed there was not evidence that his acid fast bacillus is that of leprosy.—H. Fraser & W. Fletcher, L. ii./15,13.

Liver Abscess. A form of suppuration of the liver occurring in warm climates, principally in male Europeans and in association with amœbic dysentery. (*E. histolytica* infection.) Drainage, dressing and emetine hypodermically requisite.—A. L. Candler, L. i./20,429. See DYSENTERY.

Malaria (*c.f.* also Vol. I., p. 669, 673, 867).

Etiology of Malaria. Full knowledge of all concerning the etiology of the disease will only be attained when adequate knowledge of the various species of mosquito capable of subserving the germ, of certain vertebrates capable of taking the place of man in the life cycle, of their geographic distribution, etc., is available. The malaria parasite is subserved by several species of *Anophelinae* and these are mainly of nocturnal habit—this is the existing knowledge. Whether species of *Culex*, *Stegomyia* and other *Culicinae* are efficient hosts has yet to be proved.—Manson.

To combat malaria in India and other places where it is prevalent it is necessary:—

(1) To improve the surface drainage and prevent the formation of puddles where the larvæ can breed, also to remove the vegetation surrounding such, and for the wealthy to do away with or cleanse weekly the ornamental waters in their gardens. Smoke is a wonderful protector against malaria, and it is customary in certain parts to burn dung and such-like during the night in huts and stables.

It has been found that formaldehyde evaporised from tablets of Paraform is of little avail to kill mosquitoes in a room—probably Sulphur Dioxide would do more, or nitrous fumes made by action of Nitric Acid on copper, or even a little Nitric or Sulphuric Acid strongly heated in the sealed room—destructible fabrics being removed—would be more successful.

(2) Protection by means of wire gauze.

(3) Distribution of quinine, *vide* also Vol. I., p. 669 (quinine is distributed gratis by the country pharmacists to the poor in Italy).

The young *Culex* larvæ have been proved to survive desiccation for several months. Certain of the adult culices (*Culex impellans*) appear to prefer to attack birds rather than human beings, the avian blood being recognisable on dissection of the insect.

It is a remarkable fact that so far inoculation experiments on all animals excepting man have proved unsuccessful, and in the case of man the inoculation should be intravenous. Experiments have found, however, that malaria can be produced by allowing infected mosquitoes to bite healthy individuals.

The *Anopheles* larvæ are easily found in the winter in sun-exposed, grass-surrounded pools in the infected districts in India.

The method of killing the larvæ, and indeed, all other water insects, beetles, &c., is to pour common kerosene on to the surface with the aid of a sprinkling water-can. This forms a scum, which prevents the larvæ from breathing the atmospheric air. They die and sink to the bottom, or are washed up on to the banks in countless numbers. Thirty pounds of oil will cover at least 2,000 square yards of water; the dose of paraffin should be repeated about 20 times during the year.

"Bamber Oil." Citronella Oil (not lemon grass oil) $1\frac{1}{2}$, Kerosene (Paraffin) Oil 1, Cocoa Nut Oil 2, to which is added 1% Carbolic Acid. As a preventive against malaria instead of the mosquito net. Its efficacy lasts 4 to 6 hours—sufficient for a night's sleep when a net is not available.—C. Christy, L.ii./17,482.

Rice cultivation with the necessary stagnant water is no small source of increase of malarial disease.

Major Ronald Ross has stated that in spite of all ascertained facts *re* malaria, in spite of the parasite having been cultivated in the insects over and over again, in spite of the infection having been produced experimentally in men and birds by their bites, &c., &c., not one in 20, even in malarial districts, believes the theory. Extirpation of mosquitoes in tropical countries needs Government action.

There remain a few difficulties to settle in the mosquito theory, *e.g.*, how it comes about that the proportion of infected mosquitoes reported in certain districts was only 1.6%, whereas the percentage of natives suffering from the disease was high as 48.5%. Again, large tracts of land in Erythrea have no human inhabitants. It is possible to contract malaria by sleeping there in the open for a single night; how does the insect causing that infection (which it undoubtedly does) become infected?

Occurrence of malaria without the agency of Anophelines. Outbreak in Picard Island in the Seychelles, Anophelines were searched for, but were not found. Possibly *Culex* or *Stegomyia*, which were present, may in certain circumstances act as carriers, but on the other hand the Anophelines may have been borne by ship.—L. ii./09,237; B.M.J. ii./09,99.

The decadence of Greece due to malaria and its consequences.—B.M.J. ./09,1349.

Recurrence of malaria after 7 years application of bacteriological methods concerning immunity to protozoa useless.—B.M.J. ii./09,769.

Sir J. Cantlie relates that Quinine, Calomel and Salicylate had no effect on malarial fever and neuritis, whilst a change of air and exercise effected cure. Advice as to climate for malarial sufferers.—B.M.J. ii./09,769.

Prof. Ronald Ross advocates systematic *enumeration of the number of organisms* present in men or animals infected with given parasites. The mere detection of the parasites is not enough,—by counting before and after a dose of a drug, more exact criterion of its effects could be obtained. 'Counting' in 33 cases of malaria,—one of *P. Malariae*, eight of *P. Vivax*, and 24 of *P. Falciparum* showed that the numbers of asexual forms diminished after the febrile period until about the middle of the apyrexial interval, after which they gradually increase until they are numerous enough to cause a relapse. Quinine is not immediately lethal on all the parasites. Methylene Blue and Soamin have little effect on the asexual forms, though the former is thought to affect crescent forms, which remain very refractory to quinine.—'Enumeration' under Quinine is wanted.—L. i./11,585. For information on the subject—the number of parasites that may be introduced by the mosquito—the reader is referred to "MALARIA PREVENTION" by Major Ronald Ross:—

He advocates a study of the numbers and local distribution of the particular anopheline mosquitoes which are found to transmit malaria in a given locality, an accurate measure of the amount of malaria present in a particular population under Quinine and other preventive

measures, the estimation of the number who show signs of present or recent infection by enlargement of the spleen, the constantly-sick-rate, the death-rate, etc. He concludes that the most generally useful of these is the *spleen-rate*, since an actual microscopical examination of the blood demands too great labour. In this connection it is stated, reasoning shows that in a quarter of an hour a careful microscopical examination of a sample of blood for parasites will only have searched 1/50th of a C.mm. *Since this volume is only about 1/150,000,000 of the blood in a man's body, it follows that there is a considerable chance that not a single parasite might be detected, although the individual might have 150 million of them in his circulation at the time!*—From a review.—Na. Dec. 29, 1910.

Anti-mosquito measures in India. Second meeting of the **General Malaria Committee**. Investigation of the *Leishmania* type of diseases allied to malaria, viz., *L. donovani*, the parasite of Kala-azar, *L. tropica*, the parasite of oriental sore, and *L. Infantum*, the parasite of infantile splenomegaly in N. Africa essential. Educational anti-malaria measures necessary. Quinine prophylaxis should go hand in hand with general sanitation and destruction of *Anopheles* breeding grounds. *Stegomyia* may prove an even greater danger in the immediate future in India in view of the importation of yellow fever.—B.M.J. i./12,23.

Fairs are prolific sources of malaria in India. Result of investigation of a village away from *Anopheles* breeding grounds where constant infection occurred.—L. ii./12,1387.

Insects and War. The mosquito—means of prevention and accurate description.—A. E. Shipley, B.M.J. i./15,797.

Egyptian Expeditionary Force, Malaria in, during 3½ years. Epidemiology, microscopy, etc., concerning (1) Egypt and the Canal Zone, and (2) Palestine, Caused by 2 species of parasite—the benign tertian and the malignant or subtertian. The quartan appears to be almost non-existent in Egypt and to occur rarely in Palestine.

The main mosquito intermediary in the benign tertian zone in Palestine appears to be *A. Maculipennis* and in the Jordan Valley *A. Palestinensis*.—P. Manson-Bahr, L. i./20,79.

Quinine Treatment:

For the Quinine Treatment of Malaria see Vol. I., p. 669, 673, also p. 867. The following are recent notes:—

Subtertian malaria treated by Eusol. 60 Cc. maximum intravenous dose.—B.M.J. i./20,303.

Uganda, Malaria in. Routine treatment Quinine Hydrochloride *per os*, sometimes intramuscularly in addition.—J. A. Taylor, B.M.J. i./20,113.

Macedonia, Malaria in. On the earliest appearance of cerebral symptoms quinine intravenously. This saved many lives—10 grains in 20 Cc. found best.—A. G. Phear, L. i./20,195.

To cure malaria one must act quickly and drastically. Once the relapsing stage supervenes nature and time alone will bring about the desired result, though Quinine may assist.—R. U. Moffatt, B.M.J. i./20,60.

Hydropathic treatment of malaria better than Quinine.—T. Zangger, L. i./20,766.

Quinine intramuscularly causes extensive necrosis of muscle and its therapeutic value is negligible in comparison with other methods.—A. R. Balmain, B.M.J. i./20,381.

There is no decisive experimental proof of the superiority of injections of Quinine.—Sir R. Ross, B.M.J. i./20,130.

Quinine reinforced by subcutaneous injections of Fluorescein or Eosin 0.01 to 0.06 Gm. in Saline. Fever subsided rapidly.—B.M.J.E., i./20, 50.

Post malarial anaemia treated by Galyt.—J. Graham Forbes & R. F. Lunn, L.i./20, 493.

Malaria recurrent well treated by N.A.B.—arguing by analogy that malarial fevers and syphilis are protozoal infections.—J. N. D'Esterre, L. ii./20, 552.

Malarial Parasites.—The mosquito theory of this disease was established by Sir Ronald Ross (the winner of the 1902 Nobel prize) after Sir Patrick Manson and others had paved the way, as explained subsequently. The *Culex pipiens* or common mosquito it is thought does not convey malaria. It is the Spot-wing or *Anopheles maculipennis*, also belonging to the *Culicidæ* which carries infection.

No fewer than 82 genera of the *Culicidæ* are now described.—Allbutt.

The female *Culex* has the palp much shorter than the proboscis, whereas that of the female *Anopheles* is almost the same length as the proboscis. The body of the *Anopheles* stands at an angle with the surface on which it is resting, whereas the body of *Culex* is almost always parallel with it.

The female is frequently found with its body 'blown out' with blood which it has imbibed. This *Anopheles* is common throughout the world. The males are harmless as far as blood sucking is concerned. The Midges (*Chironomidæ*) which dance and 'swarm' in the evenings are quite harmless. Important differences in venation and hairs on the wings enable one to distinguish between *Culicidæ* and *Chironomidæ* with certainty. The *Anopheles* goes through the stages of ovum, larva, and pupa; the mosquito lives in the water.

Laveran, the discoverer of the parasite of malaria which is known as *Hæma-mœba malaricæ*, previously called *Plasmodium* or *Hæmatozoon malaricæ*, divided it into the following phases:—1, spherical bodies; 2, flagellated; 3, crescent; 4, rosette forms.

(Some observers, contrary to Laveran, have been of opinion that the different types of malaria are due to different species of the organism.)

The whole life history of the *Plasmodium* will be found illustrated by some excellent models at the Natural History Museum, South Kensington, London. Briefly in the tertian form the spore, which is freely swimming in the blood plasma enters the corpuscle. It develops amœboid movement and then shows pigmentation owing to changes in the hæmoglobin. A nucleus is developed. The rosette form is the next change owing to division of the Karyosomes. On breaking up, the spores are liberated into the blood, the spore emission being synchronous with the attacks of renewed fever.

There are two distinct cycles of existence, one in the human being (asexual) and the other (sexual) in the mosquito.

Classification of the Malarial Parasites.

That adopted by Manson in his "Tropical Medicine" and generally accepted may here be briefly cited and the résumé on the subject in our last edition has been carefully revised to fall into line in this matter.

The forms of the parasite and of the diseases they give rise to are divisible into two groups—the benign and malignant.

The benign parasites never form crescent bodies, whilst the malignant, or at least the most important of them—the subtertian, do; *i.e.* the gamete of the benign parasite is a sphere or disc, that of the malignant parasite a crescent.

Clinically, the benign parasites rarely give rise to pernicious attacks, the malignant frequently do.

(i.) Benign Parasites are of two kinds: **Quartan** parasites with cycle of 72 hours, causing, *i.e.* fever recurring every three days—'Quartan Fever'; the other, the **Tertian** parasite with cycle of 48 hours, causing fever every two days—'Tertian Fever.' (In deeply stained preparations of the tertian parasite the hæmoglobin of the red blood corpuscles in question will be dotted over with granules known as **Schuffner's Dots**—a feature of some diagnostic value.)

(ii.) Malignant Parasites are in three forms, perhaps more: a pigmented parasite, the **Subtertian** (*Syn. Æstivo-Autumnal* of the Italians or **Tropical** of Koch) of 48, or approx. 48, hours' cycle; a pigmented parasite—**Pigmented Quotidian** of approx. 24 hours' cycle; and an unpigmented parasite—**Unpigmented Quotidian**—also approx. of 24 hours' cycle.

The name **Haemozoin** suggested by Sambon is now used instead of **Melanin** hitherto to define the black or reddish-black particles seen in the protoplasm of the malarial parasite in the red blood corpuscle an hour or two before the occurrence of a paroxysm of the characteristic periodic fever in question.

Until the concentration of hæmozoin which precedes the formation of spherules in the human body phase of the life cycle of the malarial parasite takes place the particles are scattered, being located principally in the outer zone of the parasite.—Manson.

The mosquito-malaria theory was formulated by Sir P. Manson in 1894. From the fact that the flagellated body does not come into existence until the blood has left the blood vessels—that is until it is outside the body—he concluded that the function of the flagellum lay outside the body—in fact that the flagellated body was the first phase of the extracorporeal life. As the parasite while in the circulation is always enclosed in a blood corpuscle and therefore unable to leave the body of its own efforts its removal must be effected by some blood sucker. The mosquito was correctly suspected. Sir Ronald Ross proved finally in 1898 the extracorporeal phase of the parasite.

The well-known diagram of the asexual (endogenous) or human phase of the parasite with the mosquito, exogenous or sexual phase, is not sufficient to clear up the life history of the parasite. There is possibility of *another phase*. There are districts in India, Africa, and elsewhere practically uninhabited on account of the prevalence and virulence of the local malaria. As man is absent, one could theorise that the life cycle cannot be effected.

The explanation is animal intermediary (bat, monkey, ox, sheep, etc.) or again the parasite may pass from one mosquito to another without intervention of a vertebrate by passage of the sporozoite into the mosquito's eggs. The matter is dealt with in Manson's "Tropical Medicine."

'**Remittent Fever**' (a clinical term as distinct from a classification of type of parasite). As it has been found that what was designated remittent fever is produced by either quartan, tertian, subtertian or quotidian parasites the name is now discontinued.

Mosquito-malaria theory. A very useful summary of the proof of the theory, commencing with the discovery of the parasite by Laveran in 1880.—Sir Patrick Manson, B.M.J. ii./17,103. See also R. McCarrison, *ibid* 109.

It has been computed that $\frac{1}{4}$ billion parasites must be present to produce fever, but in an experimental "inoculation" not one parasite could be found in the blood during the first three days of fever, while during the last three days as the fever subsided parasites were found.—M. D. O'Connell, L. i./20,518.

Staining Methods.

Films of blood smeared evenly with a very small quantity, *s.a.*, dried in the air, not by aid of a flame, and fixed by immersing in alcohol and ether, equal parts, 10 minutes, may be stained with aqueous methylene blue and eosin, or with methylene blue alone, 5 minutes, or with a Hæmatoxylin Stain, or by **Leishman's Stain** (*q.v.*). With Leishman's Stain fixing is not necessary. **Muir** says the structure of the parasites is well brought out by the following.—Soak film in Saturated Corrosive Sublimate Solution a few seconds. Wash well, stain with hæmalum 10 minutes, wash, stain again for about the same time with aqueous methylene blue. Wash in water, dehydrate, clear in Xylo and mount in balsam. The chromatin of the parasites is violet blue, and the protoplasm pure blue. The Leishman method is, however, principally in use. Consult Allbutt's *System of Medicine*, or M. & R.

Leishman's Stain made by dissolving 1 Gm. of the powder in 200 Cc. Methyl-Alcohol and 12 drops 1% NaOH added. Used for general purposes. In staining, stain for 30 seconds with this then dilute with distilled water about 1 in 4 for a further 2 to 3 minutes. Wash with distilled water and drain. **Gauducheau's Stain** used when Leishman's fails. It consists of Borcl's Blue mixed with Eosin. The former can easily be made up from Silver Nitrate and Methylene Blue.—P. Manson-Bahr, L. i./20,79.

Malaria—rapid method of Diagnosis.

Thick Films are examined—the thicker part first before even dry—the diffuse and fine dots of tertian, the compact and coarse dots of quartan, and the peculiar arrangement of the pigments in the crescent in tropical malaria are very characteristic—not to mention pigmented leucocytes, be sure the pigment is on the same level as the red corpuscles and disappears totally on focussing up and down.—J Cropper, B.M.J. i./12,890.

Panama, the most difficult place to rid of the scourge, nevertheless *Anopheles* and *Stegomyia* practically abolished from the Canal zone.—B.M.J. i./07,401.

Cultivation of Malaria Parasite from the blood of an untreated patient was effected by Bass (1911) in 50% Glucose solution.

Locke's fluid employed, omitting Calcium Chloride but adding human serum or ascitic fluid, the addition of Dextrose being generally advisable. The cultures were carried on for four generations. Leucocytes had to be excluded from the culture medium as they phagocytosed the parasites at the period of segmentation.—Review of Tropical Diseases.—Pr., Aug., '13,218.

On cultivation of the malarial parasite in vitro. 51 cases.—L. S. Dudgeon and C. Clarke, L. i./17,530.

Schlesinger's Solution (Zinc Acetate 1, Alcohol 10).—As test for malaria depends on the fact that Urobilin always present in the urine is increased in amount in this disease. Take 1/3rd test tubeful of urine, add equal volume of Schlesinger's Solution and then a few drops of a weak dilution of Iodine Tincture. Absence of fluorescence is strong evidence against acute malarial fever.—L. i./13,1803.

Malignant Oedema. *Bacillus Œdematis Maligni*, Koch. *Syn. Bacillus Oedematis, Vibron Septique of Pasteur.*

Obtained from surface garden soil, dung, dust, putrifying matter, etc. Anaerobic—Single rods 3 to 10 μ in length frequently in cultures in long filaments. Stains Gram—, in this differing from *Bacillus Anthracis*. Gas forming. Liquefies gelatin. Spores very resistant—may be kept for months in the dry condition.—M. and R.

The organism was often found in gas gangrene in the war. See GAS GANGRENE.

Mediterranean Fever. *Syn. Malta Fever* or **UNDULANT FEVER!**

Mediterranean fever is treated chiefly with intestinal disinfectants—benzonaphthol, salol, urotropine, &c. The fever is almost completely wiped out from the Army and Navy by restrictions on goats' milk. (A very large proportion of the goats in Malta are constantly passing *M. Melitensis* in their milk). If the civil population were sufficiently enlightened to follow suit, there would probably be an end to the disease. Boiling the milk is all that is necessary, and the ortol and peroxide of hydrogen test is becoming popular as a means of proving that this is done where servants cannot be trusted.—Ph. Notes.

The fever is characterised by long irregular pyrexia, frequent relapses, hæmatic complications, constipation, with no ulceration of Peyer's patches. Incubation period 6 to 9 days. Temp. may be 106°, fatal 110° F.—Gould.

History of the combat with Malta fever. In 1886 Bruce found in the spleen of fatal cases of Malta fever the *M. Melitensis*, and by inoculating this into monkeys proved it to be the cause of the disease. Twenty years afterwards the fever was stopped, and no further diagnosis methods (by Widal's reaction) were required.

Malta Fever Vaccine.

Sometimes proves of service in cases presenting only slight signs of intoxication where the pyrexia nevertheless tends to persist, also in cases of localised infection supervening upon an attack. The initial dose of 25—50 millions may be repeated in about 5 days, or sooner if the temperature fail to fall or tend to rise again. **Ampoules** contain 25, 50, 100, 250, 500, 1000 and 2000 millions.

Prophylactic dose 1000 millions repeated or increased to 2000 millions. Interval 7 to 10 days. Total 5000 million advised.

Important points in treatment are rest and warmth.

B. Mesentericus is the cause of ropiness in bread. It can be prevented by adding a little Acetic Acid to the dough (0.3 lb. per sack of flour). The *Watkins Test* is employed. To 7 sterilised Test Tubes add 1 to 7 Cc. of 20% suspension of the flour in distilled water which has been kept in a beaker in boiling water for ½ hour—to kill all organisms except the spores of the organism in question. Incubate at 28° C. for 24 to 48 hours. If the tubes indicate no ropiness at end of that time the flour is sound.—C.D. ii./17,616.

Pellagra.

Pellagra is found in Europe, Africa, Asia, America, and even in Oceania, and probably affects more or less seriously over a million people. It is a disease of long duration, characterised by a peculiar rash, not unlike a severe sunburn which appears on the face, round the neck, and on the back of the hands and feet. This eruption recurs each year at determinate seasons (spring and autumn); it appears suddenly under the influence of exposure to sunlight, stands out some days, then fades off gradually, and is followed by long persistent desquamation. Together with the eruption other symptoms appear. They are irregular fever, frequent fits of giddiness with a peculiar sensation of falling backwards or forwards, great debility, confusion of mind, copious salivation, insomnia, pyrosis, and diarrhoea. These symptoms abate during the summer months and disappear almost entirely in winter, especially in early cases. They return with the rash each spring. After a period of progressive aggravation, which may last three, five, or thirty years, the patient becomes greatly emaciated, partly paralysed, and entirely demented. A number of these unfortunate beings commit suicide, as a rule by drowning; the majority end their days in the lunatic asylums of their respective countries. The disease affects the agricultural classes almost exclusively; town people are everywhere absolutely immune.

PELLAGRA FIELD COMMISSION.—Eating of Maize either sound or deteriorated can no longer be considered the cause of pellagra. A parasitic infection possibly conveyed by some insect. Pellagra occurs in districts where the sand-fly *Simulium* exists.—L. W. Sambon, L. ii./10,1709. B.M.J. ii./11,613.

Treatment by direct transfusion of blood. The recoveries (58%) following transfusion in the grave type of cases compares most favourably with the recoveries (10-20%) in the same type of case in which other therapeutic measures are employed. A few days after the transfusion gradual increase in body weight and improvement in mental condition was noticed. Recovery was established in a period varying from one to four months. No advantage has been noticed in the employment of a donor who has recovered from pellagra as compared with the donor who has never had pellagra.—B.M.J. ii./11,1276; L. ii./11,526; see also Investigation of.—L. ii./10,1709; L. ii./11,556,1524. In Egyptian prisons they are now using maize bread.—L. ii./11,916.

Pellagra is not transmitted by contact or association of persons. Although in Europe only the rural inhabitants are affected, in America it occurs among urban residents and even the well-to-do are not immune. Of all drugs perhaps Arsenic has most value as a remedy—it is best given *per os* as Fowler's Solution increased to 20 or 30 minims three times a day. Intramuscular injections of Sodium Cacodylate, Sodium Arsanilate, and Arsacetin have given good results in early cases.—Charles R. Box, Pr. June, '13, 940.

Pellagra in Great Britain.—An account of four cases with description of the histological changes in the nervous system, also a history of the disease. Sambon believes pellagra to be an insect borne infection probably conveyed by a species of *Simulium*, a biting insect which passes its larval and pupal stages in running water. The disease is common in Italy. It has been showed to be endemic to a limited extent at least in some of the eastern districts of Scotland north of the Forth.—C. R. Box and F. W. Mott, B.M.J. ii./13,1.

See also B.M.J. (Leader) ii./12,1155, *vide* also L. W. Sambon, B.M.J. ii./13,119,297, also 570, 584, 1445 (Leader on Etiology), 1773.

Blackbirds transmit?—L. ii./12,251.

New theories and investigations concerning pellagra. G. Alessandrini believes he has established that the malady owes its origin to an exactly localised "something" found in drinking water and only in such waters as arise in or traverse stagnant or argillaceous soil. There is an absence of pellagra where clear and running water is drunk and a presence of it where stagnant water is used. Drainage and introduction of artesian wells cause disappearance.

The latest investigations by Alessandrini and Scala point to the disease being a chronic poisoning brought about by the silica in colloidal solution in water. It seems to be attributable to mineral colloids. Clay is the first cause of the evil. Rain water reacts on the clay (Aluminium Silicate) hydrolysing it to Silicic Acid and Aluminium Hydroxide.—A. Cencelli, L. i./15,794.

Review of existing knowledge and various causal theories all of which are detailed above. Pellagra may be a **deficiency disease**. There are

analogies between pellagra and beri-beri. The paper contains some experimental work dealing with guinea-pigs fed on good and bad maize plus cabbage.—F. M. Sandwith, L. ii./15,905.

Pellagra in Egypt. A syndrome occurring most often in the underfed.—A. D. Bigland, L. i./20,947, see also J. I. Enright, *ibid* 998, 1018. Also Helminthic infections as a factor.—H. M. Woodcock, *ibid*, 1193. H. F. Harris has issued a work on the subject which is well spoken of.—L. i./20,1272.

Deficiency of Protein.—W. H. Wilson, L. ii./20, 719, 765; see also *ibid*, 788.

In **Antigua** Pellagra thought to be endemic. Analysis of cases shows it is found among the blacks who live on cornmeal plus a generally inadequate and improper diet, not among the whites, who are really more susceptible to it, who eat cornmeal plus an adequate and varied diet. The facts indicate that while not incompatible with the theory that it is conveyed by *Stomoxys calcitrans*, they are most in accord with the theory that the causative agent is not bad food but **deficient food**.—W. M. Macdonald, L. i./15,127.

Pinta, a disease caused by a fungus, producing discolourations on uncovered parts of the skin.—B.M.J. ii./05,1270.

Pityriasis Versicolor, due to fungus growth under the skin, common in the tropics.—B.M.J. i./05,1271

Bacillus Pestis (Bacillus of Bubonic Plague).

The Plague.

“The **symptoms** of plague in man develop within a few days of infection, and consist of fever, headache, giddiness, weakness with staggering gait, great prostration, and delirium. In 75% of the cases the lymphatic glands in the groin, armpit, and other regions are inflamed, infiltrated and much enlarged, constituting the ‘buboes,’ hence the name ‘bubonic plague’ frequently given to the disease. In the remaining cases the lungs may be primarily attacked; the ‘pneumonic’ form, or a severe blood infection may develop, the ‘septicæmic’ variety; in both of these buboes are absent, or are a late development if the patient lives. Occasionally an eruption of pustules or carbuncles appears on the skin, a phenomenon frequently mentioned by the older writers, and abscesses may form in the buboes. The bubonic form is hardly infectious or even contagious but the pneumonic variety is highly infectious, owing to the presence of large numbers of the infective agent, the plague bacillus, in the expectoration from which it is readily disseminated in the air. In some instances the patients do not appear particularly ill, and are able to go about, though such cases are liable to sudden death from heart failure.”—T. R. Hewlett, Na., Dec. 23, 1911.

Out of 50,000 cases of plague in an epidemic in Manchuria only two or three undoubted bubonic cases were observed, all the rest were pneumonic. The duration of the disease was usually less than two days and no cases in which bacteriological diagnosis was complete were known to recover. Vaccination cannot be relied upon to give even reasonable means of protection against pneumonic infection. *An efficient mask affords the only reliable protection.*—Review of Tropical Diseases, Pr., Aug. '13, 218.

The Local Government Board issued a memorandum by G. F. Newsholme at the time of the outbreak in England. This draws attention to the infected eyes and thick drunken speech. For a criticism of this memorandum by G. F. Petrie, see p. 504.

In addition there is the well-known tendency to “shouting” delirium and the impulse to patients to get out of bed and wander off, utterly heedless of their condition,—as seen in the natives of India.

For the **treatment** of plague are: 1. **Yersin's Curative Serum**, also used as a prophylactic. 2. **Haffkine's Plague Prophylactic** against plague. This contains the dead bodies of the bacilli preserved by 0.5% Phenol, as well as the products of their growth. The immunising substances are contained in the bodies of the bacilli, *i.e.*, in the solid matter in the fluid and in the fluid itself. It is a killed culture of *Bacillus pestis*.

Yersin's Curative Serum of the Lister Institute is sent out in 20 Cc. bottles.

Dose.—At the earliest possible moment 50 Cc. intravenously and 100 Cc. subcutaneously, *e.g.*, in the flank, repeated in 12 to 24 hours. 20 Cc. is given as a preventive. The Yersin Serum may be prepared by cultivation of a

virulent growth of the bacillus obtained from several epidemics. An emulsion of the growth on physiological salt solution is injected intravenously into the horse in gradually increasing amount—the first few doses having the bacilli killed by heat. Bleeding takes place a fortnight after the last dose. The serum is finally tested for efficacy.

Haffkine's Plague Prophylactic is supplied in tubes of 20 Cc.

Protection is afforded probably for upwards of a year. After injection there is local swelling and probably general malaise and heightened temperature. *Immunity* is conferred after 7 or 8 days by an injection.

Dose.—For men 1 Cc., women $\frac{1}{2}$ Cc., for children over ten $\frac{1}{4}$ Cc., under that age $\frac{1}{20}$ – $\frac{1}{10}$ Cc. May be repeated in 10 to 14 days. *Site of Injection*.—Subcutaneously in any loose tissue free from veins, e.g., the flank. *Shake the bottle*.

The number of cases among the inoculated reduced by between 68 and 100%, and the number of deaths by between 79 and 100% as compared with the incidence of attack and deaths among the non-inoculated in the same place.—L. ii./07,145.

Verjbitski's contribution on the part played by insects in epidemiology of plague, also other Reports by the Advisory Committee appointed by the Secretary of State for India, the Royal Society and the Lister Institute.—B.M.J. ii./08,91.

'Curative' Serum is not satisfactory. The culture of *B. pestis* killed by heat, to which a minute quantity of Phenol is added, gave excellent results at Kirkee, in India, in the epidemic in 1906. The dose was from $\frac{1}{2}$ to $\frac{1}{4}$ Cc. Strychnine appears almost specific for the disease.—B.M.J. i./07,928.

Plague treated by (autogenous) Vaccine,—simple culture on Agar from patient,—dose being about 75 to 80 millions. Good result in non-septicaemic cases. 79% recovered.—R. Row, B.M.J. ii./13,1021.

Bacteriology.

Morphology.—Short fat bacillus. On staining with weak aniline dye shows marked polar staining. Spores have not been demonstrated. Non-motile. Does not retain the stain when treated by Gram's method; grows well on usual media (? potato) both at room and body temperature. Does not liquefy gelatin. Occurs in chains when grown in fluid media. Forms typical stalactite growths in bouillon and in presence of butter fat, but must be kept undisturbed (Haffkine). Man is inoculated through the broken skin.

The bacillus produces alkali in its growth equivalent to 1.5 to 2.5% normal Sodium Hydroxide Solution, in 6 to 8 weeks. This effects arrest of growth, but not death of the bacillus.

In smears made at an early stage of the disease from the buboes, expectoration or blood respectively in the three varieties of plague, the bacillus is present in enormous numbers, and the films show "polar staining," the centre being hardly stained at all; this is characteristic. In older lesions peculiar, large, rounded or ovoid "involution" forms of the bacillus are met with. The organism is readily destroyed by heat (60° to 65° C. for ten to fifteen minutes), and by disinfectants. The plague bacillus is pathogenic for a number of animals, in addition to man—the rat, mouse, guinea-pig, rabbit, hare, ferret, cat, monkey, etc. In the United States the ground squirrels are attacked.—R. T. Hewlett.

Epidemiology.

Rat-flea Plague theory. Clinical experience shows that plague has no preferential temperature, though the Third Report of the Plague Commission sought to establish a "climatic plague temperature" of 85° to 50° F. Calcutta is remarkably free from human fleas; dog fleas are prevalent on the other hand, and rat fleas are seldom or never found. Rat fleas do not bite men, on the contrary they have a strong distaste for the skin of man. Evidence of equally conclusive nature in the opposite direction by a Member of the Commission. There is always an association between rats and plague in India.

A remarkable feature which has characterised plague from the earliest times is the alternation of periods of widespread prevalence, "pandemics" with periods of quiescence and complete intermission. There have always been localities in which plague has been "endemic," i.e., continuously prevalent, for example, on the Persian Gulf, in Asia Minor, and in Yunnan, a province of China bordering on Burmah and Tibet. Infection from man to man is almost negligible, the rat fleas being the intermediaries between the rat

and man, and mechanically conveying the infection—the plague bacilli—from rat to rat, and from rat to an (*vide* an article by Dr. Petrie in "Nature," Nov. 3, 1910, p. 15), the destruction of rats is therefore essential. The disease exhibits a marked seasonal prevalence. In Poona plague is epidemic only from July to February; August, September, and October being the months of maximum prevalence. This period corresponds closely with the extent of flea prevalence on the rats. An epidemic terminates naturally, owing to a combination of adverse factors, *e.g.*, decrease in the number of fleas, decrease in the number of rats, and an increase in the proportion of immune to susceptible rats. In some instances plague cases may be completely absent between the seasons of prevalence, but by what means the infection is kept alive in the intervals has not yet been determined. Rats are occasionally met with suffering from what has been regarded as chronic plague, but the latest investigations of the Indian Plague Committee indicate that the condition is one of recovery from plague infection, and the condition is stated to possess no significance in the seasonal recurrence of the disease among the rats. The recent outbreak of plague in Suffolk, though in itself insignificant is disquieting owing to the fact that plague-infected animals—rats, rabbits, hares, a ferret and a cat—have been met with in five districts in Suffolk, in one district in Essex, and in the London Docks, indicating a somewhat wide distribution of infected localities.—R. T. Hewlett, Na., Dec. 22, 1910, p. 237.

The character of the disease seems to change from bubonic in summer to pulmonary plague in the cold season.—L. ii./11, 1311.

Notes on the **L.G.B. Memorandum on Plague.**

The "ambulant" form of plague is referred to, and it is stated that persons with this type of the disease may spread the infection. Spread of infection by such persons would seem, however, to be very doubtful by direct personal contagion at least, and it is equally doubtful whether effective carriers of the disease in the sense of typhoid carriers exist. The evidence for the existence of such carriers is not satisfactory, and although the possibility of the occurrence of "pneumonic" carriers must be considered, the rarity of this type, at least in India, and its extreme fatality, considerably limit its importance from this point of view.

There is little or no liability to infection from contaminated food. This is justified by the accurate observations on the pathology of human plague made some years ago in Bombay by the Austrian Plague Commission, and by the results of experiments on susceptible animals. The memorandum deals fully with rat destruction. Kitasato has reported that in five years 4,800,000 rats were killed in Tokio alone at a considerable financial outlay, but that at the end of this time no appreciable decrease in the rat population could be detected. Kitasato attributed this to the circumstance that the rate of destruction, vigorous as it was, did not keep pace with the natural increase in the rat population. Recent experience in India appears to point in the same direction. It is beyond question, however, that so far as plague prevention is concerned, a great deal can be done in this country by diminishing or, preferably, abolishing rat infestation in human habitations and in their immediate neighbourhood.—G. F. Petrie, Na. Nov. 19, '10, 81.

The chance of human infection is determined by the number of hungry infected rat fleas, provided they will feed on man, and their accessibility to man. It is pointed out that by various reasons there is not so great an 'accessibility' amongst Europeans as in India. The importance of finding plague infected rats at Wapping in June, 1911, would be greatly exaggerated if it were measured by Indian experience. This is higher up the river than places where plague-infected rats had been previously found.—B.M.J. i./11, 1476.

The **Plague in China** and the far East in the winter of 1910 and early spring of 1911, was of the **Pneumonic Type**—the more severe form—a very large proportion of the natives and Europeans attacked died. Up to April, 1911, the outbreak claimed 46,000 victims. The first outbreak in the winter of 1910 was among hunters of the rodent *Arctomys bobac*, known in English as the marmot, in Russia as the tarabagan, and in Chinese as the hanta,—an animal susceptible to epizootic plague infection. It was spread by these men returning home. The extreme cold induced an indoor existence, so parties of coolies travelling through the country slept under conditions of constant intimate contact—there is little evidence of infection having been contracted in the open air. Those towns that had adopted preventive measures

before they became badly infected practically escaped. Isolation of patients and their contacts, and disinfection, when efficiently carried out, have invariably been followed by diminution of the death-rate. Amongst the rats examined no instance of plague infection was found.—International Plague Conference, L. i./11,1117,1118,1152,1162. See also L. i./12,688.

The **proportion of pneumonic cases** in this epidemic caused some alarm. Though latest experimental evidence indicates that bubonic plague can only be caused by infected fleas, yet the writer has seen the transmission from the pneumonic to the bubonic without rats or fleas. The happiest thing to occur regarding the outbreak would have been for this pneumonic outbreak to become bubonic,—combined with the enforcing of sanitation in the infected area so as to limit the spread of the epidemic.—Pr. May 11, p. 623.

The transmission of Plague.

Plague is apparently the only bacterial disease transmitted to man through the medium of an insect. The rat flea combines the functions of culture tube and an inoculating needle with respect to spread of the epizootic, the blood imbibed by the flea being the culture medium. In a plague epidemic there are three conceivable infective agents:—the infected rat, the infected rat-flea and the infected human being (or human carriers). It is pointed out that if infected fleas were fed on rats immune to plague the infectivity of such fleas was much diminished. Immune opsonins in the imbibed blood favour the phagocytosis of the bacillus in the flea's stomach. The rat with acute septicæmic plague would seem to be the ultimate reservoir of the plague bacillus.—B.M.J. ii./10,1505.

Cats as plague preventers in India. They should come first in preventive measures.—B.M.J. ii./10,305.

PLAGUE, SPREAD OF, B.M.A. DISCUSSION.—A history of Plague investigation starting with the discovery of the bacillus in 1894 by Kitasato and Yersin. Rats and the spread of, and true relation between epizootic and epidemic. Transference from rats to man. Chance of survival of the bacillus if deposited on soils and floors, viability of the bacillus in soils, food-stuffs, etc., alimentary infection, feeding experiments, transmission by fleas, experiments in flea-excluding houses, etc. Seasonal prevalence, the rat-flea hypothesis. The coincidence of the epidemic season with the period of greatest flea prevalence seems to point to the position occupied by fleas as carriers. Rat fleas readily feed on man.—C. J. Martin. Opening paper,—B.M.J. ii./11,1249, *et seq.* This paper is a comprehensive resumé with a lengthy bibliography of facts established by the research of the Indian Plague Commission.

Flea infected clothes in India are spread on sand in the direct sunlight. in 45 minutes all are killed.—B.M.J. i./11,1293; P.J. i./11,740.

PLAGUE AND ENGLISH LIFE.

The effect of plague in the past upon English national life has been very deep. Every English hedgerow is a reminder of plague. The hedgerows mark the change in land tenure which followed the Black Death. The pestilence produced a scarcity of labour which gave the final blow to villeinage and serfdom, and when farming in common ceased it became necessary to define the fields. From that period dates the emancipation of the English labouring classes. Plague helped to kill the textile industries of the Eastern Counties and laid the foundations of the modern prosperity of Lancashire and Yorkshire. It was largely responsible for the decline of the power and wealth of the monasteries, and thus brought nearer the Reformation. It facilitated the growth of English literature. Up to the time of the Black Death, French was the principal language of the schools and of the wealthy. So many teachers died in the epidemic that a new race of educationists arose who insisted on giving instruction in the English tongue, and the way was hereby paved for "Piers the Ploughman" and Chaucer. Europeans are no more exempt from plague than Asiatics. Their only protection is that their mode of life does not bring them into close contact with rats, or with the rat fleas.—From a news article on the scattered outbreaks in England in 1911.

The only *true infectious cases* are the *pneumonic type*, and in these infection can readily be avoided by skilled nursing. The rat-fleas constitute the danger more than the rats. The fleas in question are not the ordinary kind,—they do not as a rule bite human beings.—B.M.J. ii./10,1454. This is negated by the abstract.—B.M.J. i./11,1476, *antea*.

Haffkine's Preventive Treatment which has saved many thousand lives is fully described in a pamphlet issued by the Research Defence Society.—B.M.J. ii./10,1471.

A small percentage of pneumonic cases in an outbreak is by no means a law of the disease.—B.M.J. ii./10,1658.

Cow Dung as a Preventive.—This, it appears, is largely used in the huts in India—being spread on the floors liquid is allowed to dry—it is probably a source of great danger from tubercle, etc.—L. i./12,700.

On the length of life of the rat-flea apart from its host.—B.M.J. ii./12,926.

A case of plague on a grain ship in the Tyne. Post mortem examination gave typical *B. Pestis*.—W. J. Tulloch, L. ii./13,1318.

The Tarbagan (Mongolian Marmot) and plague. Exhaustive investigation into its possible cause of spread of plague. Not nearly so important as the rat—in this respect almost negligible.—L. ii./13,529.

Tenth report on Plague investigation in India (Plague Supplement, Nov. Journal of Hygiene). Review and abstracts.—L. ii./17,22.

Bed Bugs as plague distributors—small likelihood of it.—L. ii./17,832.

Pneumonia.

Fraenkel's Pneumococcus.—1. Prepare films from 'rusty' portion of sputum. 2. Stain by Gram's method and counterstain with eosin half to one minute. Stain other films by carbol-fuchsin. Overstain (five minutes). Slightly decolourise with weak acetic acid. (For capsule.)

To obtain a pure culture, the blood of a mouse dead from inoculation of sputum is sown on blood agar or Nasgar medium. Will not grow below 37° C.

Recognition.—Diplococcus (ends are often pointed—*Diplo lanceolatus*) sometimes occurs in short chains of four to ten cocci. Has a capsule, but this is absent in cultures. Gram +.

Pneumococcic peritonitis in children, 15 cases reported.—L. i./06,1591.

Vide also Vol. I., p. 868 *et seq.* and Vol. II., p. 491 *et seq.*

CONJUNCTIVITIS, BACTERIOLOGY OF.—In a school outbreak an organism morphologically identical with the pneumococcus but differing in fermentative activity and its non-pathogenicity to animals, usually highly susceptible—L. ii./11,1418.

In cataract cases (at Prague) examination for pneumo and streptococci by growth in **Elschnig's Culture Medium**, *vide* Culture media, is made and if found operation postponed with hourly applications of 1 in 5,000 Mercury Oxycyanide Solution until the organisms have disappeared. Simultaneously an Agar culture is made for diagnosing variety of Staphylococci if present.—E. W. Thomson, Glas. Med. Jl., Feb., 1913.

Growth of the pneumococcus: Sir A. E. Wright's Serum Glucose Broth

1% Peptone, 1% Lemco, 2½ to 5% of human serum and an amount of alkali fixed by neutralising to Phenolphthalein and then adding 6 Cc. of normal acid to each litre of medium. 1% Glucose was found a valuable addition—the broth so made gave copious growth of pneumococcus.—L. i./14,1.

Friedlander's Pneumobacillus.—Present in only small proportion of cases of pneumonia. Common in influenza. Gram —, but stains well by carbol fuchsin.

Recognition.—A bacillus varying considerably in length; usually short, with rounded ends. Has a capsule. Is easily cultivated on all ordinary media.

Characters.—Best examined by dark ground or parabolic illumination Gram—Stain by Gram's method but do not wash with alcohol, and omit any counter-stain. Hot Acid-Fuchsin gives good results.

For the recent work on division of pneumococci into numerous Types, see Vol. I. p. 870, 871.

Polyomyelitis (inflammation of the gray matter of the spinal cord). The virus of polyomyelitis stands midway between the finest and coarsest examples of 'filterable viruses.' It is highly resistant to drying, light and chemical action. In dust, especially with protein matter, it survives weeks and months—in diffusive daylight indefinitely and it resists the action of Glycerin and Carbolic Acid in 0.5% solution for months.—S. Flexner, L. ii./12,1451,1790.

Bacillus proteus vulgaris occurs frequently (50% of examinations) in chronic aural discharges. Like the colon bacillus, it stains with difficulty

unless previously treated with iodine or potassium permanganate. It is Gram—and about 3μ in length, but may grow into long leptothrichial threads. It is nearly always associated with foetor, and has the reputation of being a powerful ptomaine producer.—M.P., Sept. 23, '08. Some have considered this organism the cause of Weil's disease, *q.v.*

Rabies. HYDROPHOBIA is an acute infectious disease communicated to man by bites of animals suffering from rabies.

Antirabic Vaccine. A dead Carbolized Rabies Virus made by Sir David Semple's method can be sent to any locality where treatment can be carried out without losing its properties.

A Central Institute could supply the whole of India with Vaccine, patients would hence be saved long journeys to Pasteur Institutes where the preparation of living vaccine is carried on. Most important of all the treatment would be early,—this is the essence of success, and the treatment is free from all risks.—*Vide* Sir D. Semple, Sci. Memoirs by Officers of the Med. and San. Dept. of the Indian Govt., 1911, also L. ii./11,173.

Cultivation.—H. Noguchi has by the method used for isolating the spirilla of recurring fever isolated two distinct micro-organisms from cultures prepared from the brain or spinal marrow of animals infected with hydrophobia. One is a minute corpuscle almost ultramicroscopic, the other, which is constantly reproduced in successive cultures, a larger nucleated corpuscle which more resembles protozoa than bacteria. These nucleated corpuscles multiply rapidly both by budding and fissure. They vary from 1 to 12 microns and by the ultramicroscope show a central nucleus surrounded by a very distinct refringent membrane. Inoculation with cultures, in which either the granular or the pleomorphic organisms predominated, caused the death of the animal with all the typical symptoms of rabies.—*Presse Medicale*, 1913, (73)729, per P.J. i./14,219.

Rabies and Antirabic Treatment.—Sir D. Semple, B.M.J. ii./19,333,371.

Reading Bacillus. Salt packs thought to act by rendering a wound anaerobic. The observation was made that salt packed wounds doing well gave off an offensive odour. An anaerobic organism was isolated and the suggestion was made that wounds should be packed with salt or sphagnum and sown with the living culture. Morphologically the organism was similar to *B. oedematis maligni*. Non-pathogenic. In appearance a rod somewhat torpedo shaped having a fairly large subterminal spore. Actively motile. Numerous long flagella. Gram positive. Stains easily with other stains, but is not acid-fast. Liquefies gelatin. Pathogenicity: As many as 30,000 millions of living bacilli have been given to guinea-pigs without death or any other disturbance.—R. Donaldson and J. L. Joyce, L. ii./17,445.

Relapsing Fever, Syn. Recurrent Fever, is associated with the presence of *Spirochaeta Recurrentis*, *Syn. Sp. Obermeieri* in the blood. In cases of relapsing fever terminating fatally the blood is frequently found to be teeming with the organisms. The corpuscles with the $\frac{1}{2}$ inch oil immersion lens frequently appear to have slender spiral filaments attached to them, causing a rippling movement of the blood which persists for several hours when examined in the fresh condition.

Relapsing fever, Transmission by Ticks.—B.M.J. i./13,65.

Noguchi has cultivated four species of pathogenic spirochetes occurring in the blood (as distinct from those which invade tissues—*Sp. Pallidum q.v.*) and that of yaws). The pathogenic blood Spirochetes cultivated include *Sp. Obermeieri* which is the cause of relapsing fever in Europe and the spirochaete of the fowl. He also has grown (nonpathogenic) Saprophytic Spirochetes, *e.g.*, *Treponema macrodentium*, *T. microdentium*, *T. mucosum*, *T. refringens* and *T. calligyrum*—a new species standing morphologically between *T. pallidum* and *T. refringens*.—B.M.J. ii./13,1100.

S. Hata cultivated Spirochetes of Recurrent Fever in a medium containing Horse Serum and buff coagulum. The virulence of cultivated spirochaetæ is relatively weak. Sir Wm. Leishman showed evidence of granule shedding in spirochaetosis and the development of the spirochaeta from the granule.—Int. Cong. of Medicine, 1913, L. ii./13,569.

Infection in lice by the spirillum of recurrent fever is hereditary contrary to previous views. The spirilla occur in the lacunary cavity of the insect not in the mouth organs or digestive apparatus. Inoculation does not take

place from bites but through wounds in the animals caused by scratching. The animals become infected by the nails with fluid from crushed lice.—Ann. Inst. Pasteur per P.J. ii./13,729.

Indian Ink method of staining is best.—*c.f.* Syphilis Chapter.

Relapsing Fever in Palestine.—W. K. Calwell, L. ii./20,785.

See also Tick Fever p 529.

Ringworm Fungi. Rapid Clinical Method of Search:—

- (1) Soak the hairs in Potash Solution 10 minutes.
- (2) Wash in water to free from Alkali.
- (3) Mount in Glycerin or Glycerin Jelly.

For permanent stained sections:—

- (1) Soak the hairs in Potash Solution 10 minutes.
- (2) Stain with Aniline Gentian Violet (*q.v.*) for 1 hour
- (3) Absorb excess of stain.
- (4) Treat with Gram's Iodine Solution 2 minutes, wash in water. Decolourise with acidified Aniline Oil (Aniline Oil 10, Nitric Acid 1) for 15 to 20 minutes. Treat with Aniline Oil 1 minute, clarify in Xylol, and mount in Balsam.

The organism of *Favus* is *Achorion Schonleinii* those of *Tinea tonsurans* (RINGWORM OF THE SCALP) and *T. circinata* (RINGWORM OF THE BODY), *i.e.*, non-hairy skin, are *Microsporon Audouini*, *Tricophyton Megalosporonectothrix*, and *endothrix* (according as the fungus lies outside or inside the hair), that of *Tinea (Pityriasis) versicolor* is *Microsporon Furfur*.

Ringworm of the Scalp is rare in the adult.

Tinea Barbae or *Hyphogenic Sycosis* (Ringworm of the beard) is a common affection of the beard. The common grey coccus inhabiting the upper layers of the epidermis may cause an infection and cause pustulation, but the fungus can be distinguished from this coccigenic variety. Syphilis may also sometimes simulate ringworm of the beard. *Eczema Marginatum* is a name for ringworm attacking the groins and axillæ. *Onychomycosis* or ringworm attacking the nails only—not common, but very troublesome.

Cultivation of Ringworm Fungi is possible on all ordinary media, but the addition of Glucose or Maltose is most favourable.

270 Ringworm patches in school children treated by X-rays. With exception of 5 cases, all were due to *Macrosporon Audouini*, 3 were due to *Megalosporon endothrix*, and the other 2 to *Tricophyton ectothrix*.—B.M.J. ii./09,454.

Suggested study of the question as to whether pediculi capitis are not carriers of ringworm infection.—thought to be so.—B.M.J. ii./11,780.

Contagiousness of Favus in man.—R. Sabouraud, L. ii./19,581.

See also **Dhobie's Itch** p. 478.

Scarlatina or Scarlet Fever.

The viruses of scarlet fever, typhus fever, foot and mouth disease, measles and poliomyelitis are all filterable. The greater number of diseases known to be due to filterable viruses affect the domestic animals—pleuro-pneumonia of cattle, African horse sickness, cattle plague, etc.—L. ii./12,1451.

Dr. Vipond, of Montreal, succeeded in isolating a spore-bearing bacillus from the mingled colonies of various organisms in cultures obtained from the enlarged glands of a child who died of scarlet fever and subsequently from six other cases, sometimes in pure growth.

The organism is a long bacillus with rounded ends, feebly motile, and an active spore former. It stains variably with Gram's method sometimes showing a beaded structure. It grows well and rapidly on ordinary media. Monkeys have been inoculated with broth cultures and have exhibited enlargement of the lymphatic glands within 48 hours and well marked red rash in five days. One of the five monkeys died and from the glands *Post mortem*, the bacillus was recovered in pure culture. Requires confirmation.—Pr. July, 1912,70.

Opinions from the majority of 27 isolation hospitals in Great Britain were to the effect that too much importance has been attached to the **desquamation** as a source of infection. Milne, of Barnardo's Homes, does not isolate fever cases in any way, relying entirely on swabbing the throat with 10% Carbolic Oil and rubbing the body all over with Eucalyptus Oil. The poison in 99% of cases enters by the throat, hence patient is not free from infection till the throat is quite healthy again.—C. H. Phillips, L. ii./12,522.

p-Dimethylamidobenzaldehyde Test.—2 Gm. of this substance triturated with 30 Gm. Concentrated Hydrochloric Acid and diluted with 70 Cc. of water. A few drops of this solution added to the urine will by the red colour produced at once on heating confirm a suspected case of scarlet fever. Depends on urobilinogen which is present in true scarlet fever.—M. 1913.

Streptococcus Conglomeratus Vaccine is prepared, but has not been subjected to a very considerable trial.

In most cases, with or without albuminuria, *Streptococci* are voided by the urine in large quantities in this fever.

Various Drugs, taken internally or used locally, may occasionally, especially where idiosyncrasy exists, produce scarlatina-form rashes, e.g., Venice Turpentine applied.—B.M.J. i./13,712.

Serpent Venom. Anti-venene.

In the preparation of this serum the venom is removed either from the living snake or after killing it. This venom is mostly desiccated over sulphuric acid *in vacuo* and a weighed quantity of this is dissolved in sterile water and injected into the horse. The increase in dose proceeds very gradually; the final dose appears to be about 0.6 Gm. of venom, equivalent to the entire yield of 20 average sized snakes. The serum is removed in the customary manner and standardised.

Calmette showed that the venom of all snakes is of a similar nature, and obtained his remedy by the inoculation of horses with the poison of the cobra di capello; his serum possesses a strength of 1 in 20,000; that is to say $\frac{1}{20,000}$ Cc. subcutaneously injected into a hare of two kilos in weight suffices to protect it from snake poison which kills a similar hare in eight hours.

It is claimed that anti-venomous sera are specific even between the venoms of a species of the same genus. An account of the serum therapeutics of a number of cases.—L. ii./04,1273. *Vide also* L. i./06,1231.

Calmette has described the hæmolysins of snake poison; in addition to these bodies snake poison contains neurotoxins, which act on the nervous system, and cytolsins dissolving other tissue elements.—Bull. de l'Inst. Pasteur 'T.'

Dose.—Anti-venene is supplied in tubes of 10 Cc. This amount or as much as 40 Cc. should be injected. The serum should be as fresh as possible. (As much as 400 Cc. intravenously and 10 or 20 times that amount, if subcutaneously, for cobra poisoning.—L. ii./04,1273.) The injection requires to be made at once, or within an hour in man; death seldom occurs from serpent poison under three hours.

The dose of venom injected by a healthy cobra is about ten times as much as was assumed by Calmette, therefore the dose required to neutralise the poison should be ten times as much as that recommended by Calmette and Lamb.—Ghosh.

A ligature must be bound above the bite if possible. The wound should be opened up and washed with Chromic Acid or Gold Chloride 1% solution.

Sleeping Sickness, see Trypanosomiasis.

Sporotrichosis (due to *Sporotrichon beurmanni*).—A case of, treated by liberal doses of Potassium Iodide—80 grains per diem. Locally Iodine in the form of Gram's Solution is useful. The Iodine appears to act indirectly by stimulating absorption. Patient was in addition suffering from a ringworm infection (*Tricophyton Rosaceum*) of the nails. Cultural characteristics and peculiar properties of the fungus suggest that it may be overlooked. In all granulomata which cannot be clearly attributed to the ordinary causes of such lesions the possibility of Sporotrichosis should be kept in view.—B.M.J. ii./11,1.

Sporotrichosis of the eyes, a number of cases. Sporothrix isolated from the pus from broken down nodules. Large doses of Potassium Iodide followed by rapid improvement both of the iritis and general condition.—Oph., 1911.

Beurmann states that there are several Sporotrichoses according to nature of the numerous parasites cited. That due to *S. beurmanni* is the most frequently met with. It has been found in many localities (cited). Full description of the parasite, parasitology, etiology, pathogenesis and diagnosis.—B.M.J. ii./12,290.

Spotted Fever of the Rocky Mountains resembles symptomatically typhus exanthematicus. Supervenes on the bite of a tick *Dermacentor venustus*.—Manson.

Sprue and Hill Diarrhœa.—Features are sore tongue, stomatitis peculiar form of diarrhœa, due to varieties of bacteria. Milk diet recommended. Trilactine (*q.v.*) should prove of value.

Staphylococci are easily recognised by their grouping. They are Gram + and smaller than streptococci, but whether *S. Aureus*, *albus*, or *citreus* cultivation gives growths, *e.g.*, on a tube of Agar, of the colours in question. They are the most easily grown of all the pathogenic bacteria.—Wingrave on aural discharges, M.P., Sept. 23, '08, 343.

A case of hepatic abscess in which the patient had coughed up gallons of pus, arrived in England from India weighing 5½ stones—a mere skeleton. Open air treatment and a vaccine prepared from his organism (a *Staphylococcus*) obtained from the sputum restored to health (weight 12½ stones). Dose commencing with 5 million and advancing to 100 million. Examination of the blood prior to making the Vaccine showed patient's resisting power to this particular organism was non-existent. Other cases due to *S. lanceolatus* and *Staphylococcus aureus*.—Hale White and Eyre.—L. i./09, 610, 1588. See also Emetine, Vol. I.

A case of recurrent attacks of fever with endocarditis disturbance (Streptococcic infection) every three or four weeks, had an index falling to about 0.5 or lower just before the attack. After 4 or 5 days 1.2 or over when the attack ceased,—falling again after a week or two. A special Vaccine when the index had dropped to its lowest, caused a rapid rise and complete abortion of the attack. The injections were repeated several times with good result. A recurrent case of this kind throws light on the problem of recurrent sore throat with the possible sequel of endocardial infection.—Pr./09, 650.

Streptococci (Gram +) in aural discharges of two types —

(1) *S. longus* (*S. pyogenes vel erysipelatus*) in long chains, (2) *S. brevis* in short chains is held to be pathogenic (*S. longus vel S. Salivarius*) which is common in the mouth and throat is said to be non-pathogenic. Marmorek, however, holds that the length of chain is variable, and Widal has shown that the non-pathogenic forms from the mouth when cultivated with B. Coli become pathogenic.—Wingrave.—M.P., Sept. 23, '08, p 343

See also **Septicæmia. Vaccine Chapter. Vol. I. p. 874.**

Neutral Red Egg Medium for cultivation of Staphylococci, see **Culture Media.**

Syphilis.—Spiroñema Pallidum.* Syn. Spirochæta Pallida. Treponema Pallidum.

Spiroñema Pallidum has been cultivated by Noguchi. Absolute anaerobiosis is necessary.

Serum water, to which a piece of sterile rabbit tissue (preferably kidney or testicle) has been added, is inoculated from the artificially infected testicular tissue of the rabbit (not from human lesions). The Serum (in test tubes) is rendered suitable for anærobic cultivation by a layer of Paraffin Oil poured upon its surface. After the first cultivation strict anærobiosis is not essential—the organism can be subcultured on to solid media such as gelatin or agars. The first growths are usually contaminated by other bacteria. Two methods are suggested for separating these from the Spirochætæ:—(1) To grow the Spirochetes through filters which retard the passage of other organisms, or (2) a method depending on the fact that in stab cultures the Spirochetes grow away from the line of puncture into the surrounding medium, while other bacteria fail to do so. Noguchi states that Spirochetes cultivated by these methods are pathogenic in so far that after inoculation into the rabbit's testicle they produce characteristic histological changes and are found growing freely in the infected tissue.—H. Noguchi.—Jl. A. M. A., July 8, 1911, per L. ii./11, 536. B.M.J.E. ii./11, 48.

Noguchi's discovery of the Spirilla in the cortex cerebri of general paralysis.—B.M.J. i./13, 464; ii./13, 44.

Sp. pallidum has been transmitted from the brain of general paralytics to the rabbit by prolonged course of injections. Symptoms similar to those of general paralysis in man have been produced and the blood gave a positive Wassermann reaction.—B.M.J. ii./13, 1100, *c.f.* also **Relapsing Fever.**

* New name by Med. Res. Com. (B.M.J. ii /18, 318).

Alive may well be seen by parabolic or dark ground illumination, *vide infra*. Dead by mixing film with liquid Indian Ink.—*vide Burri's Ink, infra*. The use of **Collargol** is satisfactory.

Demonstration: As they chiefly infest the lymph stream, the spirilla may be obtained by "needling" base of ulcer or adjacent enlarged gland. Make film, fix in warm air, and stain 12 hours by Giemsa's Solution at 37° C obtained only with difficulty from surface of ulcer.

Characters.—Gram negative. Smaller than *Sp. foetida*: regular and symmetrical corkscrew spirals, shorter than *Sp. buccalis*, greater number of turns. *Vide infra* for differentiation from other *spirochetes*

Life Cycle of the Organism.

McDonagh regards the long incubation period of syphilis as due to the cycle of changes which the organism must undergo before it can give rise to symptoms, and puts forward in explanation that one dose of Salvarsan, though it kills every spirochete in a chancre, does not cure syphilis—the reason being that other forms of the parasite are present which are not killed by Salvarsan. The *Spirochæta pallida* is never seen to divide, though present in enormous numbers in syphilitic lesions; this fact suggested that it was the end formed—the male sexual cycle. McDonagh states:—The commencement of the cycle is with a sporozoite or infective granule which by its mobility reaches and enters a cell, usually a mono-nuclear leucocyte. The sporozoite in some cases increases in size inside the cell, in other cases it divides—where there is no division, the development goes on until spirochetes are formed—the male sexual cycle. In the case where there is division, one half runs the course of the male sexual cycle, whilst the other runs the course of the female sexual cycle, the latter at this stage seeming to leave the lymphocyte. The act of fertilisation was not seen: the result of fertilisation is the production of a zygote within which by subdivision sporozoites are formed and ultimately set free to start the sexual cycles again. McDonagh classes this organism with the sporozoa, and suggests that the parasite is a leucocytozoon, which should be called the leucocytozoon syphilis. The infection is probably conveyed by the sporozoite and not by the *Spirochæta Pallida*.—P.R.S.M., Nov., 1912; P.J. ii./12,809. See also L. ii./12,1011,1178,1650; Pr., Dec., 1912.

The syphilitic spore has been shown to differ chemically from all the other phases met with in the life cycle of the '*Leucocytozoon Syphilides*.'—B.M.J. ii./13,1611.

Complicated life cycle of *Sp. Pallidum* not agreed to by D'Este Emery. It remains a spirochete throughout.—L. i./14,222.

Directions for taking Specimens from a Chancre.—*Sp. Pallidum* are most abundant in the margin and in the deeper layers of the base of a chancre. The specimen should contain a minimum of blood cells.—C. H. Mills, L. ii./16,952. See further, p. 513.

Giemsa's Stain.—We have worked to a considerable extent on the subject of this stain and provide the details of our findings to assist our friends.

To start with we give the following data from Muir & Ritchie's "Manual of Bacteriology, 7th edn., 1919, p. 114.

Giemsa believes that the reddish-blue hue characteristic of the Romanowsky Stain is due to the formation of methyl-azure, and he has prepared this by a method of his own under the name "Azur I." From this by the addition of an equal part of medicinal methylene blue, he prepares what he calls "Azur II." and from this again by the addition of eosin he prepares "Azur II-Eosin." The formula for the finished stain is as follows:—

Azur II-Eosin 3 Gm., Azur II. 0.8 Gm., Glycerin 250 Gm., Methyl Alcohol 250 Gm.

This stain has been extensively used for demonstrating spirochetes, but it can be used for any other purpose to which the Romanowsky stains are applicable. For spirochetes the following are Giemsa's directions:—

1. Fix films in Absolute Alcohol for 15 to 20 minutes. Dry with filter paper.
2. Dilute stain with distilled water—one or 2 drops of stain to 1 Cc. water (the mixture being well shaken).

(Sometimes the water is made alkaline by the addition of one drop of 1 per cent. Potassium Carbonate to 10 Cc. water.)

3. Stain for 15 minutes (a longer period is often desirable, even 12 or 24 hours).

4. Wash in brisk stream of distilled water.

5. Drain with filter paper, dry and mount.

The method of procedure really develops into a long or rapid method :—

(1) *The ordinary or long method* consists in staining for 12 hours with 1 : 10 or 1 : 15 dilution.

(2) *The rapid method.* The same dilution is used but the slide with stain above is held over a Bunsen burner until steam rises. The process is repeated 3 or 4 times, the final application lasting 2 minutes.

The *long* method is recommended by the Medical Research Committee. Report No. 19, issued 1918.

It is obvious that the secret lies in the *elucidation of Azur I*. Numerous workers have attacked the problem.

L. Tribondeau & J. Dubreuil, *Compt. Rend.* 164, 551-3 (1917), for example, communicated a paper entitled "New Colours for microscopic use derived from Methylene Blue."

"Two valuable derivatives, Methylene Violet and Methylene Azure, have hitherto been manufactured by a secret technique. These substances may be prepared as follows :—To a 1% aqueous solution of medicinal Methylene Blue, Ammonia is added in amount equivalent to 5 to 10% of the solution and the mixture heated on a water bath to the temperature of the boiling bath. A large precipitate is formed which is filtered out hot. The filtrate is evaporated at 37 to 40°; the powdered residue is Methylene Violet. A little of the precipitate formed on adding Ammonia was collected on the filter but the greater portion remains adhering to the walls of the precipitating flask. It is left exposed to the air for 24 hours. Under these conditions the colour becomes darker blue and when this transformation appears complete, the precipitate is dissolved in water, filtered, and the filtrate evaporated as above. The powdered residue is **Methylene Azure**, about equal in amount to the Methylene Violet. Three staining solutions are made from these powders : (1) an aqueous solution of the Azure with Ammonia, (2) an aqueous solution of the Azure and Violet with Ammonia, called Polychrome Blue, and (3) a solution of Azure and of Eosin in a mixture of alcohol-glycerin 75 to 25, which the authors name Azeo.—From Chemical Abstracts 11, p, 2093, 1917. See also L. ii./18,142.

Ordinary good medicinal Methylene Blue with the addition of Eosin will produce a 'Giemsa' effect almost equal to the Ammonia treatment above mentioned, though the latter changes the tint decisively.

During the war we had occasion to make numerous experiments using many different combinations of Eosin and Methylene Blue. The stains we prepared were examined by a well-known pathologist and broadly speaking a stain of the formula :

Eosin 0.4 Gm.

Methylene Blue medicinal 0.3 Gm.

Glycerin 50 Gm.

Methylic Alcohol, Acetone-free (not exceeding 0.3%), 50 Gm.

was found to be the best of the series.

The report was :—"Differentiation good with 1 : 10 dilution. Bacteria clear and distinct. Red blood discs fairly well stained."

In the course of this work we were able to determine that the "Acetone-free" requirement for the Acetone is not entirely a fetish. Using a commercial Methyl Alcohol containing 12% Acetone the staining was not so good.

We also found that Glycerin is an essential to the stain. Without Glycerin the report was "Sediment obscures the films."

Following on this we have worked upon the **Tribondeau Ammonia treatment** described above.

Proceeding exactly as directed by Tribondeau we found the yield of "Methylene Azur" was 25% of the Methylene Blue taken and the "Methylene Violet" 35%.

Staining solutions made exactly according to Giemsa's directions were supplied to our pathologist with private marks as follows :—

L. Made with the Methylene Azur, etc.

M. Made with the Methylene Violet, etc.

N. Made with best medicinal ordinary Methylene Blue, etc., as formal previously stated.

O. Made with another maker's Giemsa Powder (who we believe holds the secret).

The interesting report was (Jan. 5, 1920):—

"The two stains *N* and *O* give the best results with spirochetes—they are about equal."

U.S. IX. apparently makes a blunder in the amount of Azur II-Eosin by directing 0.3 Gm. instead of 3 Gm. in the formula stated at the commencement of this article. It also transposes 250 Gm. to 250 mils. of Glycerin and 250 Gm. of Methyl Alcohol to 250 mils. Obviously these alterations make a serious difference in a delicate staining reagent of this description.

Azur II. in the U.S.P. is described as a mixture of equal parts of the Chlorides of Methylene Blue and Methylene Azur (Methylene Blue Sulphonate).

Long and diligent search is necessary in looking for the *Spirochaetae* stained by this method. Table of this and other *Spirochaetae*.—B.M.J. i./09,455.

This stain imparts to the spirochete a distinctly reddish violet tinge, similar to that of the neighbouring leucocyte nuclei (the Romanowsky chromatin stain), whilst the bacteria come out blue.

Giemsa's Stain sometimes succeeds in demonstrating gonococci where the more common stains have failed. It should, therefore, be included in the routine method (McKee's method, Oph. Record, Jan., 1912), S. Stephenson, Pr., Sept., '14, 378.

Examination of Unstained Specimens.

The old methods of examining the spirochaeta in the hanging drop, and by staining with Giemsa's Stain have been completely superseded by the **Dark-ground illumination**, the **Chinese ink** and **Collargol methods**.

Ultramicroscope.—Employed for demonstrating in a rapid, easy and certain manner the presence of the living organism. Useful to examine a scraping when it is necessary to give an opinion on a doubtful primary or secondary syphilitic lesion. Syphilis cannot of course be excluded because the organism cannot be detected on one examination.

The Ultramicroscope is a paraboloidal immersion-condenser. The rays of light used are deflected so that they converge obliquely on the object examined, which appears as a bright refractive body on a dark background. Transparent objects otherwise invisible are then easily seen.

Spirochaeta pallidum seen thus is an extremely fine silvery spiral from 6-15 μ in length, with very regular or closely set spirals (about 7 to the diameter of a red blood corpuscle). The spirals vary from 10-26 in number. Extremities are pointed. If so focussed that only the summits of the spirals are illuminated the organism looks like a series of bright dots, not unlike a chain of Streptococci. It is feebly motile, its movements consisting of rotations round its long axis, backward and forward movements, and bending movements, which are the most marked. It preserves its spiral form during rest.

The technique of dark ground illumination is ably dealt with by J. Edwin Barnard, Pres. Roy. Microscopical Socy. in Med. Res. Com. Rep. No. 19, issued 1918.

Sp. pallidum Method of demonstrating dark ground illumination with oil done away with. An ordinary achromatic condenser used dry with Travis' expanding stop replaces.—A. C. Coles, B.M.J. ii./15,777.

Sp. buccalis, *Sp. refringens*, *Sp. balanitidis* are much larger with wider and more open spirals. *Sp. refringens* has only 3 to 5 turns and is usually blunt at either or both ends. The only spirochaetes very like the specific organism are (1), *Sp. dentium*, found in carious teeth, which is shorter (5 to 10 μ) and coarser, 5 to 15 spirals, the wave length the same as *Sp. pallidum*, but depth of wave is considerably less; (2), *Sp. pertenuis* (yaws), Castellani; (3), *Sp. pseudo-pallida*, Loewenthal (ulcerated cancers). In the last two the spirals are not quite so deep or regular, and in the case of *Spirochaeta pertenuis* the ends are often twisted into rings or loops.

Spirochaeta pallidum is found below the surface in the lymph only and should be sought at the margin of the lesion. It cannot be detected in the centre of an ulcerated or necrosed area where the saprophytic spirochetes may be seen in large numbers. The organism is found in the largest numbers in mucous plaques, is constantly present in varying numbers in primary untreated chancres, and is usually detected in the papular syphilide and in scrapings from a recently removed enlarged syphilitic lymphatic gland.

The margin of the chancre, papules, or mucous plaque should be gently scraped till blood just begins to exude. The surface is now dried with a swab of plain sterile gauze, and then a little blood or serum expressed by decompression or by bandage. A small drop of this is removed with a platinum needle and mixed with a drop of distilled water on a thin glass-slide. A thin cover-glass is now pressed down firmly, so that only a thin layer of fluid remains between the slide and cover-glass. A drop of immersion oil is placed below the slide and on the cover-glass. The condenser must first be accurately centred. This can easily be done with a low objective (1 in. or $\frac{3}{4}$ in.) by means of concentric rings scratched on the surface of the condenser.

Any artificial light can be used—electric (arc or Nernst), gas (incandescent), or even an oil lamp. Concentrate the light to the centre of the microscope mirror. After the slide has been placed in position so that there is a layer of oil between the ultra-microscope and the under surface of slide, and after the object is focussed, the ultra-microscope must be racked up or down and the mirror adjusted till bright illumination with dark back-ground is obtained.

General or local treatment has a marked effect on the number of treponemata found, and the organisms tend to disappear after a few weeks from the site of the primary inoculation, even without treatment. Antiseptics must not have been previously applied to the sore.

Chinese Ink Method (Burri). The method is known in Germany as Tusche Verfahren.

The method requires no special apparatus. A platinum loopful of secretion from a sore is placed on a slide and mixed with an equal quantity of Distilled Water and an emulsion of Chinese Ink. The whole is mixed and spread on the slide like a blood film, allowed to dry and examined with oil immersion lens. The ink produces a dark background and the objects stand out white. It is easy to differentiate the two forms of spirochetes.

Collargol Solution 1 in 20 (store in Amber bottle) preferable to Chinese Ink. One drop with one drop of the suspected secretion to be mixed together and allowed to dry on slide, and then spread with another slide to make a thin film. The preparation is examined with $\frac{1}{12}$ inch oil immersion lens—the background is perfectly homogeneous.—L. W. Harrison, B.M.J. ii./12, 1547.

Or proceed as follows.—Make a thin film, fix by radiant heat. Pour the Collargol Solution over film, decant quickly and stand up to dry in air or incubator. Examine with $\frac{1}{12}$ th inch immersion lens.—Wyatt Wingrave.

Comparative Value of Staining Methods.—

Sp. Refringens under dark-ground illumination is seen to shoot rapidly backwards and forwards in a straight line and when not rotating so actively is often seen to squirm its way by corkscrew movements, pushing blood corpuscles, bacilli, etc., aside. The diagrams illustrating this paper show the marked difference between this organism and *Sp. Pallidum*. Serum obtained by swabbing is preferable for examinations to scrapings. In staining with *Giemsa's Stain* (diluted 1 in 8) at least 12 hours is best. In the *Indian Ink* method at least twice the volume of Indian Ink to the drop of serum. Spirochætes are more constantly present in condylomata and mucous patches and far less constantly present in papular secondary skin eruptions than in primary sores. *Dark Ground Illumination* is the best method of examination.—B.M.J. ii./11, 1283.

Gentian Violet staining of *Sp. Pallidum* —

The stain is prepared on the lines of Gram's Aniline-Violet for Bacteria:—

Shake 3 Cc. Aniline Oil with 20 Cc. distilled water for 5 or 10 minutes, and to the filtered liquid add half its volume of a concentrated alcoholic solution of Gentian Violet. Fix smears by holding over 1% Osmic Acid Solution for one to two minutes. Pour the Stain over the specimen and heat 20 to 30 seconds over a flame. Wash off with water, dry and examine with oil immersion lens. Spirochætes appear reddish-blue against a rose-colored ground.—*Sp. Refringens* being stained more deeply.—L.i./11, 321.

Lead Subacetate Method.—Fix with Osmic Acid as above, wash in water and cover for 10 seconds with a solution consisting of Liquor Plumbi Subacetatis 1, Water to 100. Again wash and cover 10 seconds with a 10% Aqueous Sodium Sulphide Solution. Wash and repeat whole process twice. Apply Osmic Acid Solution 30 seconds, wash and dry. Spirochætes, cell debris and bacteria appear black.—A. A. W. Ghoreyeb. Publications of Mass. Gen. Hosp. vol. III., No. 2, p. 367, JI. A.M.A. May 7, 1910, per L.i./11, 321.

Silver Method (Tribondeau).—Use material from infiltrated tissues around chancre not from surface. Eliminate hæmoglobin, etc., as far as possible by washing (*v. infra*). The *fixative* used consists of Formalin 2 Gm. Acetic Acid (Pure) 1 Gm., Water 100 Cc. The *Mordant* is 5% Tannin in Water. The Silver Stain is Silver Nitrate 1 Gm., in Water 20 Cc. To 15 Cc. of this add Ammonia drop by drop until precipitate redissolves; then add the remaining 5 Cc. of Silver Nitrate Solution until the solution remains slightly opaque after shaking.

Technique.—Dry smear at 37° C. Fix by washing with fixative one minute and complete by a few drops of Absolute Alcohol, allowing same to dry on the inclined slide. Add the Mordant and warm over flame till just steaming for 30 seconds. Wash, pour off excess and without drying employ the Silver Stain over a flame for thirty seconds. Wash and dry. *Sp. Refringens* and *Balanitidis* are darker and distinguished by their morphological character.—B.M.J.E. i./13,16. See also Med. Res. Com. Rept., No. 19, issued 1918.

The method is very similar to Van Ermengem's process for flagella—one cannot be certain of getting results every time.—W. D'Este Emery, Pr. Feb., 1913,462.

Congo Red—stained films acidified with dilute Hydrochloric Acid as relief staining for bacteria and spirochetes.

A small drop of 2% Aqueous Congo Red Solution is placed on the slide and a very small quantity of the bacterial culture or of the exudate to be examined is mixed with it. The drop is then spread out into a tolerably thick film. Allow to dry and wash the slide with 1% Hydrochloric Acid in Absolute Alcohol and dry in the air or films may be spread and stained afterwards and treated with acid. Examine with oil immersion lens. The background will appear as a rule uniform. Bacteria vary somewhat in relation to the dye. Mostly they are clear, sharp and quite transparent, but some will take up the dye and appear as ill-defined bluish-black bodies—this is seen chiefly in old cultures of Gram negative organisms.—T. H. C. Benians, B.M.J. ii./16,722.

An atlas of 38 plates of Spirochetes has been issued as a memorial of the late Fritz Schaudinn.—B.M.J. i./o8,278.

Persistence of disease organisms in the body. In syphilis and tubercle the respective organisms once admitted have their potentiality for mischief terminated only by death of their host. In cancer probably the same condition exists though no causative germ is known.—B.M.J. i./11,973.

Noguchi's Method of Diagnosis of Syphilis.—(*Distinguish from the Noguchi modified Wassermann and the Luetin Test.*) Boil two parts of the cerebro-spinal fluid with 5 parts of a 10% solution of Butyric Acid in normal saline for a few seconds, then add one part of Normal Sodium Hydrate and again boil briefly. A flocculent or granular precipitate is obtained on standing (in parasyphilitic affections) due to presence of a globulin. The test distinguishes general paralysis from other forms of insanity not associated with meningo-encephalitis.—L. i./o9,1666; B.M.J. i./o9,1112,1408.

Luetin Test (Noguchi's).—A skin test for diagnosis of syphilis. An emulsion of the killed bodies of the Spirochetes (killed by heating to 60° C.) The injection being made between the layers of the skin, not under the skin. If correctly conducted a small pale swelling forms which subsides in 10 to 15 minutes. A special intradermic syringe is employed. The test is analogous with the Von Pirquet reaction. A papular or pustular lesion is formed resembling a small gumma if patient is infected.—B.M.J. ii./13,1100,1106; D'Este Emery, L. i./14,222.

Ampoules are made containing 0.07 Cc. sufficient for one test. The emulsion is sterile and contains 0.5% Trikresol as preservative.

Luetin & Wassermann test compared. Former thought more delicate.—Velder & Borden, J.A.M.A., Nov. 1914, 1750, B.M.J.E. ii./15,39.

Complement-Deviation Reaction for the Diagnosis of Syphilis was first described in Deut. Med. Woch. of May 10, 1906, by Wassermann, Neisser and Bruck. It is an application of the general phenomenon of deviation or fixation of Complement first described by Bordet and Gengou in 1901.

To take blood for Wassermann Test.—A test-tube is provided with a cork drilled with two holes. Into the one is filled a 2-inch length of glass tubing to which the needle for venipuncture is attached by a 6-inch length of india-rubber tubing. The other hole is merely to allow for the escape of air while the blood is flowing into the test-tube when the vein is punctured. The sterile test-tube should be moist inside (steamed). Venipuncture is best (1) because it provides practice in puncturing a vein, (2) ample serum is thus provided for one or more modifications of the test.—Claude H. Mills, L. ii./16,954.

The **Pathological Section of the Royal Society of Medicine in 1914** and the **Special Committee upon the Standardisation of Pathological Methods** have agreed that for the Wassermann Test:

(1) The ingredients (Red Corpuscles, Antigen, Hæmolytic Amboceptor, Complement) are to be derived from *different* sources.

(2) The serum to be tested is to be inactivated before use. An independent "hæmolytic system" is to be employed consisting of red corpuscles, an inactivated hæmolytic serum, and a fresh normal serum containing complement. The hæmolytic values of the antiserum and complement are determined by a separate preliminary experiment. As the test is a quantitative reaction the titre of the reagents ought to be known.

Unanimity is wanted in the detail of conducting the test. Some prefer the use of guinea pig serum obtained on the day of the test, while others say it should stand for 17 or 18 hours. Many find the advantage in adding Cholesterolin to the Antigen, while others fear this addition may exceptionally produce non-specific reactions and so on. A positive reaction is evidence of extreme weight.—Leader, L. i./18,641.

Standardised antigen and amboceptor and adoption of standard method for all approved laboratories.—B.M.J. i./19,344. See also W. D'E. Emery, L. ii./18,547.

Fundamenta of the Reaction:

"**Complement**," (*syn.* Cytase, Lysin, Alexine), which is present in fresh blood serum (whether syphilitic or not), has the power of hæmolysing, disintegrating or dissolving blood corpuscles, *i.e.*, **Hæmolytic Action**. It is "fixed" in the reaction by the combined action of Specific **Amboceptor** which is present in syphilitic serum and "**Antigen**." It can also be destroyed by heating at 56° C. for half an hour.

The original Wassermann reaction is complicated,—in this, for example, the antigen is a saline extract of a syphilitic foetus. Subsequently various workers showed it was possible to employ an alcoholic extract of heart muscle, *inter alia*, in place of this substance, but the greatest simplification so far introduced is the use, notably by Hecht and Fleming, of the "Complement" and hæmolytic Amboceptor of the serum to be tested, operating with these on sheep's blood corpuscles.

Other modifications are those of Noguchi, Emery, and Wechselmann, which will be considered later.

If Antigen + Syphilitic Serum + Sheep's Corpuscles, be mixed together hæmolysis does not take place.

But if Antigen + Normal Serum + Sheep's blood be used hæmolysis does take place.

Similarly with Syphilitic Serum + Normal Saline Solution + Sheep's Corpuscles hæmolysis occurs.

To follow the last statement one must remember Syphilitic Serum contains Complement as well as Amboceptor, and the Complement was not previously inactivated by adding Antigen.

Antigen. (A bacillary product).

Is contained in an Extract of an infected organ, *e.g.*, syphilitic liver. An extractive of an ox heart is now used instead. It has no restraining action by itself on the Complement.

Amboceptor (*Syn. Immune body or Fixative*), is formed during immunisation, and has no restraining action by itself upon Complement. These *two* together will, however, inactivate Complement in any Serum and so prevent Lysis.

As *Syphilitic Serum* contains *Amboceptor* and *Complement*, in Hecht's or Fleming's method (*q.v.*) of applying the test the Complement is not previously inactivated, and consequently extra Serum is not required in the test (*vide infra*).

Wassermann employed as Antigen a **saline extract of the Liver of a syphilitic fœtus**, the serum of a rabbit immunised to sheep's red corpuscles as Amboceptor and fresh guinea-pig serum as Complement. The test can be done equally well with saline extracts of normal liver and other organs. Alcoholic Extracts, however, keep better. Alcoholic Extracts of the heart (human, sheep, rabbits, or guinea-pigs) are useful (other substances of a lipid nature such as Sodium Oleate, Cholesterin, or Sodium Glycocholate will do also, but Ox Heart Extract is the best).

The natural hæmolytic Amboceptor for sheep's corpuscles in human serum was found to be as useful as that of the immunised rabbit which was dispensed with, but the Complement of the guinea-pigs' serum was still required. Hecht made the serum to be tested supply the Complement as well as the Hæmolytic Amboceptor. He employs small quantities in comparison with the test as originally described.

For **Fleming's Method** of conducting the test are required,—

Antigen (Ox-Heart Extract) :—

Heart muscle 1 Gm. is ground up with 5 Cc. Absolute Alcohol and heated at 60° C. for one hour and then allowed to stand 24 hours at 37° C. The supernatant liquor is poured off and diluted with Normal Saline Solution before use in such proportion that while completely binding the Complement of a syphilitic serum it will not interfere with the hæmolytic power of normal serum. Too large a percentage of Alcohol must not be present, as if used hæmolysis will take place when sheep's corpuscles are added even in the absence of serum. No extract should be used which requires to be in a strength exceeding 10%, *i.e.*, Alcoholic Extract 1, Normal Saline 9. The strength of the Extract is tested by taking say 1, 2½, 5, and 10% and using each with a syphilitic and a non-syphilitic serum in the manner described. The strength is chosen which will completely prevent hæmolysis with the syphilitic serum, but which will have no effect on normal serum. Heart Extract thus prepared retains its activity for a long period of time.

'**Antigen**' **Sterules** are prepared. Another form of 'Antigen' as above mentioned is

Sodium Glycocholate Solution but is far less reliable.

Sodium Glycocholate 1, Sterile Distilled Water to 100.

N.B.—This must be fresh, as the solution is favourable to bacterial infection.

Instead of the usual Alcoholic Extracts of Ox Liver or Guinea-pig heart as Antigen it has been found that **Lecithin** and **Lecithin plus Cholesterin** are more sensitive as Antigen.—*B.M.J.* ii./11,748.

Action of Cholesterin and its derivatives on Lecithin as Syphilitic Antigen and as hæmolysin with Cobra venom.—*Jl. Path. Bact.*, Oct. 1911

Washed Sheep's Corpuscles, from the fresh blood suspended in Normal Saline. Remove fibrin from fresh blood by clotting—rapidly stirring at the time of drawing from the animal. Centrifugalise and pipette off the Serum. (**N.B.**—A powerful centrifuge is required.)

Add Normal Saline Solution and again centrifugalise several times to free from Complement. Finally dilute with Normal Saline Solution making approximately a 10% suspension.

Sterules of Washed Sheep's Corpuscles Suspension are prepared and may be relied upon for a reasonable time.

The Corpuscles can be preserved by adding a small proportion of *o.m.p.* Cresol without affecting the reaction.—Wyatt Wingrave.

Method of conducting the test

In carrying out Fleming's modification of the Test, the first requirements are the bent capsules (Wright's) as full as possible of (a) normal, (b) patient's and if possible of (c) a known syphilitic blood. To fill a capsule break off the tips of same, and after pricking the first or second finger about a $\frac{1}{4}$ inch away from base of the nail or other convenient place, make the blood flow into the bent end of the capsule by capillarity. This is done by swinging the arm, bending down so that the hand is at a level of the foot; winding a bandage several times tightly round first and second joint and intermediate portion of the finger,—then, after pricking, as indicated, with a "flamed" needle, it is possible by flexure to produce a flow of even 5 Cc. of blood if desired. The blood may, if preferred, be collected similarly from the lobe of the ear. Having at least half-filled the capsule, both ends are carefully sealed, avoiding heating the Serum as much as possible, and the Serum is allowed to separate naturally or by the aid of a centrifuge.

Make a file mark round the normal blood capsule just above the level of the Serum and break off carefully. Next snap off the end of an Antigen Sterule and finally treat a "Normal Saline" Sterule in like manner.

Make a small mark on the stem of a long-pointed **Wright's 'pipette'** (3-inch pieces of $\frac{1}{4}$ -inch glass tubing drawn out into a 6-inch capillary point and provided with a teat at the thick end) with a paraffin pencil about half an inch from the point. This is termed 1 volume,—a similar mark is made 2 inches from the point indicating four volumes. Draw up with this pipette volumes of the various liquids and introduce into diminutive corked tubes (about 1 inch \times $\frac{3}{8}$ inch) in a small rack in two rows, as follows:—

	1 volume Control Serum, 4 volumes "Antigen."	1 volume Syphilitic Serum, 4 volumes "Antigen."	1 volume Patient's Serum, 4 volumes "Antigen."	4 volumes "Antigen."	
Back Row	B.	D.	F.	H.	J. X
Front Row	A.	C.	E.	G.	I.
	1 volume Control Serum, 4 volumes Normal Saline.	1 volume Syphilitic Serum, 4 volumes Normal Saline.	1 volume Patient's Serum, 4 volumes Normal Saline.		

Tubes G.H. and I.J., etc., can be used to do two or more patients' sera simultaneously.

Into X place 4 volumes of "Antigen" alone.

In all the above the "Antigen" is to be diluted 1 volume with 99 volumes of Normal Saline in a separate little tube or Cc. measure before taking up the volumes. It may be necessary, however, to vary the strength of this "Antigen" dilution from time to time. Its strength should first be tested by taking various dilutions, say 1 in 100, 1 in 40, 1 in 20, 1 in 12, 1 in 15, etc., and using each with a syphilitic and a non-syphilitic serum—that strength being chosen for conducting the reaction which will completely prevent hæmolysis with the syphilitic serum, but will have no effect on the Normal Serum.

Insert corks and shake the contents of each tube slightly and maintain at 37° C. for one hour. After which add 1 volume of washed Sheep's Corpuscles to each tube, including "X," and incubate again for from 1½ to 2 hours.

The results are then read off, but sharper differentiation is obtained if the tubes are inserted in the ice chest for several hours so as to allow of sedimentation in the non-hæmolysed tubes.

We shall get:—

Hæmolysis in "A," owing to absence of "Antigen" and Specific Amboceptor.

Hæmolysis in "B," owing to absence of Specific Amboceptor.

Hæmolysis in "C," owing to absence of "Antigen."

NO Hæmolysis in "D," because Complement is fixed.

Hæmolysis in "E," owing to absence of "Antigen."

NO Hæmolysis in "F," if patient syphilitic, owing to added "Antigen," otherwise Hæmolysis as in "B."

NO Hæmolysis in "X" should be observed.

Note tubes "C" and "D" are only for control purposes and need not be used in routine work. The process is an exceedingly delicate one, and the original article by A. Fleming (L.M. i./09, p. 1512) should be studied—these notes are only a *resume*.

In some cases there is a deficiency of Amboceptor to sheep's corpuscles shown by absence of hæmolysis in tube A, C, E, G, or I. If so, repeat the test, but before adding the sheep's corpuscles add a small quantity of hæmolytic Amboceptor in proportion of 1 to 500 of Corpuscles Suspension, and shake. Or, add to each of the tubes containing the serum concerned one volume of Normal Serum (heated to 56° for 10 minutes), which is known to have a hæmolytic power for sheep's corpuscles. This deficiency, however, only occurs in about 10% of cases.

In a very few cases the addition of Complement may also be necessary. This can be done by adding same in the form of guinea-pig's serum containing Complement only or fresh human serum containing both Complement and Amboceptor before the first incubation period. Thus one puts in one tube (F) 4 volumes of "Antigen," 1 volume of patient's serum and 1 volume of fresh Normal Human Serum, while in the control tube "E" the "Antigen" is replaced by Normal Saline Solution.

In our hands Fleming's method has given good results. We tried a large range of dilutions of the Concentrated Antigen Solution, 1, 1½, 2½, 5, 7½, 10, 12½, 15 and 20% in Normal Saline. About a 4% Dilution was found to give the best result, but the strength requires standardising from time to time.

The following is an abstract of an account by Prof. Muir of the research leading up to the reaction:—

"The story really concerns the anti-substances which appear in the blood as the result of immunisation, and the first step was made with the discovery of antitoxins, first in the case of tetanus, and a little later in the case of diphtheria. These were the first known anti-substances, and we now know that they combine with the corresponding toxins so as to form a substance inert towards the cells of the body; beyond this neutralising action they have, so far as is known, no other effect. It was, however, shown later that a great many bodies other than toxins, such as ferments, bacteria, serum, milk, or cells of another species, might give rise to anti-substances when injected into an animal, and all such substances are now generally known as *antigens*, on account of this property. In some instances the anti-substance produced some distinct and easily recognised change when allowed to interact with the corresponding antigen. For example, when an animal was treated with injections of foreign serum, the anti-substance developed might lead to the formation of a precipitate when added to the antigen, hence it was called a *precipitin*; or again, when bacteria were used in the injections, the anti-substance might cause clumping or agglu-

tionation of the corresponding bacteria, and hence was called an *agglutinin*. The study by Pfeiffer of the serum of animals highly immunised against the typhoid or cholera organisms showed that the increased bactericidal action possessed by their serum was due to two substances, of which one was specially developed in the process of immunisation (an anti-substance), and the other was present in the normal serum; the former is now known as an *immune-body*, *amboceptor*, the latter as *complement* or *alexine*. Further researches have shown that in all cases where a dissolving action is developed during immunisation, two corresponding substances are concerned. For example, when an animal is injected with the red corpuscles of another species, its serum acquires remarkable hæmolytic properties towards such corpuscles; if the serum be heated at 55° C. for an hour, the hæmolytic property is lost, because the complement is destroyed at that temperature, but it is restored on the addition of fresh normal serum containing complement. It follows from this that corpuscles treated with the corresponding antiserum, heated to destroy complement, serve as a test for the presence of complement; if complement is present, the corpuscles will undergo lysis; if complement is absent, or has in some way been used up, the lysis will not occur. There are two other points to be noted. The first is that each anti-substance is specific (within certain limits); that is, each anti-substance exerts its effect only against the antigen which has led to its production. The other is that anti-substances are formed not only in response to an artificial inoculation, but are developed in the course of an attack of the natural disease; in other words, during the latter a process of immunisation, attended with the formation of anti-substances, appears to be going on. Accordingly, in the serum-diagnosis of disease we test for the presence of the anti-substances to the particular bacterium, and of these the two chief varieties usually considered are the agglutinins and the immune-bodies. As is now well known, the presence of the former is shown by the clumping of the causal bacterium, which occurs on the addition of the serum in suitable dilution from a case of the disease to an emulsion of the bacterium; with regard to it nothing more need be said. How can an immune-body be demonstrated? The answer is, that immune-body, along with the corresponding bacterium, will lead to the using up or fixation of complement, and thus interfere with the lysis of sensitised corpuscles when these are added to the mixture. This reaction is often known as the "Bordet and Gengou phenomenon," *c.f.* also p. 547, inasmuch as these observers showed that the injection into animals of a great many different substances as antigens—bacteria, foreign proteins, milk, etc.—gave rise to immune bodies, each of which, in association with the corresponding antigen, fixed complement, and thus prevented the lysis of sensitised corpuscles.

"Now with regard to the complement test as applied to syphilis. After the *spirochaeta pallida* had been discovered by Schaudinn and Hoffmann, 1905, and established by further researches as the cause of the disease, it seemed only reasonable to enquire whether the deviation of complement reaction was given by the serum of syphilitic patients. The observation was first made by Wassermann, Neisser, and Bruck in 1906, and it was found that the phenomenon in question really occurred. Their method was to make a watery extract of a congenital syphilitic liver, which was very rich in spirochaetes, to serve as antigen (seeing that, of course, a culture of the organism has not been obtained), and the effect of a mixture of a small quantity of this extract and of syphilitic serum on guinea-pig's complement was tested; the result, as stated, was that complement was fixed, whereas with serum from other than syphilitic cases this did not happen. Apparently, then, in syphilis, just as in various bacterial diseases, a specific anti-substance (immune-body) could be demonstrated in the blood. The subject assumed, however, quite another aspect when a little later it was found by Marie and Levaditi that an extract of normal liver and of other organs could be substituted for the extract of syphilitic liver, or in other words could take the place of the supposed antigen; alcoholic extracts are specially suitable for the purpose. Further observations showed that solutions or suspensions of substances of definitely known constitution, such as glycocholates, oleates, lecithin, and other lipoids, could be used in place of syphilitic extracts: that is, when mixed with a syphilitic serum, fixed complement. Thus, the application of the principle of the deviation of complement by an antigen and its anti-substance, as demonstrated in the case of bacterial diseases, has led up in the case of syphilis to the discovery of a phenomenon of a different nature. All that we can at present say regarding the Wassermann reaction is that there is present in the serum of syphilitic subjects a substance, *probably a modified protein, which, in the presence of other bodies, especially lipoids, leads to the fixation*

of complement and that this reaction constitutes the most valuable method of diagnosis which we possess.—R. Muir, Glasg. Med. Jl., Nov. 1910.

The **original Wassermann Test** is conducted as follows:—“About 10 Cc. of blood are removed with a syringe from a vein at the bend of the elbow, and transferred to a sterile test-tube. The serum is allowed to separate spontaneously from the clot; before use it is heated for half an hour at 57° C., then a fixed amount of the serum (0.05 C.c.) is added to a series of small test-tubes in which the fixed amount (0.6 Cc.) of emulsion of organ extract has already been placed (the organ extract is made by macerating one part of minced organ—ox liver or heart—in four parts of 96% alcohol for twenty-four hours; the emulsion is made by adding one part of extract to five parts of saline). Varying amounts of complement—normal guinea-pig's serum—are added to the series, and after one and a half hour's incubation at 37° C., the test blood suspension is added—1 Cc. of 5% suspension of washed ox's blood corpuscles sensitised with five doses of immune body from the rabbit. After further incubation for one hour at 37° C. the result may be read. Three control series are always set up at the same time as the experiment, *viz.*, (1) the patient's serum (0.05 Cc.) in saline; (2) the organ extract emulsion (0.6 Cc.) by itself—to these two series complement is added so as to estimate the inhibitory effect of each of these reagents by itself on the complement; (3) varying amounts of complement are added to saline to estimate exactly the hæmolytic dose of complement. These series are incubated at the same time as the experiment, and they also receive sensitised blood suspension.

‘The result is positive when the mixture of patient's serum and organ extract absorbs five or more doses of complement in addition to the amounts absorbed by each reagent alone. Thus, supposing that the patient's serum by itself absorbs one dose of complement and the organ extract emulsion by itself absorbs two doses, then the mixture of serum and organ extract must absorb at least eight doses of complement, as shown by absence of hæmolysis of the test corpuscles in the tube to which this amount of complement had been added, if the reaction is to be counted positive.

“The criterion of a positive reaction is based on the result of the examination of a large number of known syphilitic and non-syphilitic sera. In practice, a number of factors must be taken into account. Thus, the physical state of the emulsion of organ extract is of importance. A turbid emulsion made by floating the alcoholic solution on to the top of the saline and then mixing slowly is much more efficient in eliciting a positive reaction with syphilitic sera than is a clear emulsion made by mixing rapidly the same amounts of alcoholic extracts and saline. Again, the complement-containing serum obtained from different guinea-pigs shows individual variations, some animals yielding complement which is much more readily deviated than others. Provided that the examination is always controlled by testing at the same time as the patient's serum a known negative serum, there is no danger of obtaining an erroneous positive reaction with a non-syphilitic serum. On the other hand, a weakly positive serum may be overlooked on a single examination, but a repetition of the test will usually clear up the diagnosis.

“The reaction is essentially a quantitative one, as it depends on an accurate estimation of the amount of complement absorbed by a mixture of organ extract and serum as compared with the amounts absorbed by each reagent alone.

Browning, Cruickshank, and M'Kenzie's modification depends on the fact that the amount of complement absorbed by a mixture of serum and lecithin is increased on the addition of cholesterol if the serum is syphilitic; but not if the serum is normal. Accordingly, two series of tests are carried out simultaneously—in the one, complement is added to the mixture of serum and lecithin; in the other, to the mixture of serum, lecithin, and cholesterol. If more complement is absorbed in the second series than in the first then the reaction is positive.”—C. H. Browning, Glasgow Med. Jl. Nov. 1910

References to the Original Wassermann Method.

Doubts whether lipoids alone responsible for the test—i. e. so they must be present in enormous excess. Unlikely that such a pathological cell activity should only be found in one infection. Wassermann's Technique followed in the main. The objection to Baucr's method of making use of the amboceptor normally present in human serum in place of sheep's corpuscles is that the natural amboceptor varies considerably and in a few cases is practically absent, so that the serum of such an individual could not be tested by the method.—149 cases.—L. i./09, 1515.

The original Wassermann Test regarded as specific and reliable. Especially useful when applied to the cerebro-spinal fluid for diagnostic purposes.—Mott, B.M.J. i./09,461.

Wassermann's (original) test.—For a good description see B.M.J. ii./12,1504

Wassermann could report 1010 non-syphilitic serums examined without a single positive result. Spinal fluids from 64 cases of general paralysis and other diseases examined at Mott's request—59 of the 64 gave positive result—clinical evidence connecting tabetic and general paralysis with syphilis. Method employed essentially Wassermann's but ox blood corpuscles used instead of sheep's.—Henderson Smith and Candler.—B.M.J. ii./09,198.

Necessity for obtaining a comparatively large amount of serum overcome by diminishing amounts of reagents used. With regard to Antigen squeezer extract of a liver rich in spirochetes is best. Discussion of reliability of the test and theoretical considerations. A lengthy article with bibliography of 74 authors.—B.M.J. ii./09,1019.

Plaut (The Wassermann Sero-diagnosis of Syphilis in its application to Psychiatry) comes to the conclusion that *the original Wassermann's method is alone to be trusted*. With regard to general paralysis he considers it important to test both serum and spinal fluid.—B.M.J. i./11,760.

References to Fleming's and other Modifications.

A. Fleming on Syphilis and the Wassermann Reaction.—P.R.S.M.—Surgical Sectn., July, 1910, 219.

Objection has been raised to Fleming's and allied methods to the effect that 'hæmolytic power for sheep's corpuscles was not found in 30% of human serum, and that in 22 known cases of syphilis the reaction had not been obtained in half the number. Fleming has quoted other workers as having found 10% failures. Clemenger finds in 500 observations only 5% which did not possess hæmolytic action—does not think this will detract from value of the reaction—any deficiency can be supplied by adding a small amount of normal hæmolytic serum in these cases. Clemenger finds that 'in practically all cases of syphilitic lesions, whether primary, secondary or tertiary, a positive reaction can be obtained providing suitable heart-extract is used.'—B.M.J. ii./09,575. See also *ibid*, p. 917.

'Solving the problem of half a dozen variables.' No one has projected a simpler rationale than Fleming.—B.M.J. ii./09,1087.

Fleming reported on 12,000 samples. The number of Sera that do not possess any hæmolytic power for sheep's corpuscles is well under 10%. Sometimes the Salt Solution may be at fault, which destroys the hæmolytic power during the first incubation period.—L. ii./12,115,183,259,336.

P. N. Pantou states the Serum should be examined within 12 hours of being taken and should be stored on ice. It is important to wash the sheep's corpuscles thoroughly.—L. ii./12,48.

In the Fleming Test the blood should be examined soon after being taken. The Antigen should be controlled both by normal and syphilitic sera. A record of many cases appears in favour of the Fleming method (a syphilitic liver Antigen employed).—P. W. Bassett Smith, L. ii./12,558.

2,500 Wassermann reactions, using Fleming's modification. Quantitative tests employed by using graduated dilutions of Antigen. Thus supposing satisfactory dilution to be 1 in 15, dilutions of 1 in 30 and 1 in 60 also. It is found that by washing the sheep's corpuscles six times, thrice with Citrated Saline and then thrice with 0.85% Saline and by taking the blood from the patient on the morning of the test, a very small percentage of blood fails to give a readable result.—L. Kilroy, L. i./13,304.

The reaction (Fleming's method) in syphilis becomes + in about 3 to 4 weeks after appearance of the sore in most cases.—B.M.J. ii./13,1345.

Browning and Mackenzie's modified method. 125 out of 135 cases of syphilis gave positive reaction, and 107 out of 108 with no evidence of syphilis, gave negative results. The control cases included a large variety of acute diseases—pneumonia, enteric, scarlet fever etc.—L. i./09,1521.

Wassermann's reaction generally accepted not specific, and that it is more probably an increase in the lipid content of syphilitic serum rather than the interaction between a specific body and an Antigen that produces the complement fixation,—possibly this substance is present in all sera and that there is a marked excess in syphilis. Did not obtain such clear results when depending on the hæmolytic action of human serum instead of adding special

hæmolytic serum. 200 tests employing rabbit's heart extract. Neisser technique modified employed. Reaction not due to Mercurial treatment.—L. i./09, 1523.

Porges' modification of Wassermann (using Sodium Glycocholate). Positive reaction is definite evidence of past syphilitic inoculation.—Harry Campbell.—B.M.J. i./09, 567, 640.

Wassermann modified by using for Antigen dried syphilitic congenital liver. Primary cases marked reaction. All cases of early secondary syphilis positive results; in late secondary or tertiary manifestations results more variable 50% of para-syphilitic cases positive reaction—B.M.J. ii./09, 325, 377.

The test is useful in the diagnosis of secondary and tertiary syphilis, but not in cases of early chancres.—Pr., Oct. '10, 430; J. McDonagh, Pr., Sept. '09.

With regard to Wassermann's reaction MacDonagh (Pr., Nov. 1910 p. 671) writes as follows:—

'It was my custom to employ both active and inactive patients' serum, one serving as a control against the other; the reason for so doing was owing to the fact that in inactivating the serum at 56° C. for half an hour, complementoid bodies were formed which had the power of acting like complement, causing thereby a negative reaction in one which should have given a positive *Wechselmann* ingeniously showed that these complementoid bodies could be precipitated by barium sulphate, his method of procedure being as follows:—0.9 Cc. of inactivated serum is mixed with 3 Cc. of physiological saline solution and 0.5 Cc. of a 7% fresh precipitated barium sulphate saline emulsion, the mixture being well shaken, then put into an incubator at 37° for an hour, it is then centrifugalised and 1 Cc. is used for the reaction. The barium sulphate acts probably mechanically, and it matters little whether more than the above quantity is used.' This method should be used, 'since it not infrequently happens, that an undoubted case of syphilis, especially in the late stage of the disease and not under the influence of treatment, gives a negative reaction in the ordinary course of events and a positive with the barium sulphate prepared serum.'

Although this addition adds considerably to the labour, it, at the same time, by increasing the positive results in syphilitic cases, enhances the value of a negative reaction. The best antigen is that prepared from a syphilitic liver, and, contrary to what serves for Wassermann's reaction, an extract of a normal organ, be it human or animal, is useless. It is extremely doubtful whether this test will become generally employed and prove of diagnostic value, but, nevertheless, it is a step in the right direction. since we cannot rest in peace until we have probed the foundations of the Wassermann's reaction."

Stern's Modification has its uses. The original Wassermann being less sensitive, is less likely to mislead in diagnosis, while the more sensitive modification of Stern is more likely to give early evidence of retrogression and of the necessity for further treatment.—B.M.J. ii./11, 686, 693.

Noguchi's Modified Wassermann's Test is thought to be neither simpler than the original, nor an improvement on it. The use of human amboceptor is fraught with the danger that antibodies active to human albumins may act inhibitorily on the hæmolysis.—Deut. Med. Woch. 26, 1910, per B.M.J.E. i./11, 52. The reader is referred to Noguchi's Book on the subject for the technique.

W. D'Este Emery's Method.

Many fatty substances, *e.g.*, Lecithin, produce the same result as when Antigen is used. The substance in the serum is therefore not a true antibody, and it is, moreover, not specific, since it occurs in other diseases, and in normal serum, but in syphilis it is in excess,—hence the importance of a quantitative method of application.

All sera give some absorption of complement with liver extract if the latter be strong enough. The reaction, *may in fact be explained somewhat* as follows: The dilution of the alcoholic fatty solution produces an emulsion of fine particles. Syphilitic Serum contains a substance with power to combine with these and in so doing alters in some way the surface tension between them and the fluid in which they are suspended.—hence they clump and in doing so *attract to themselves any complement* which may be present in the fluid. The reaction is therefore partly physical and partly chemical. Note that antigen changes in strength (as a rule becoming stronger) also that the diluted extract is more turbid and has a more powerful action if the two fluids are allowed to mix gradually and not mixed at once. One or other proceeding must always

be used. Emery floats the Alcoholic Solution on top of the Saline and allows it to diffuse gradually 10 minutes, and then slowly stirs them together.

In the original Wassermann and other modifications the complement originally present in the Serum is destroyed by heat at 55° or 60°C. Emery thinks this may hide the ultimate reaction—possibly by linking together the complement and some of the so-called syphilitic antibody. The explanation usually given for first eliminating complement and then adding it in the form of guinea-pig serum is that the amount in human serum varies so much as to make the test unreliable. Emery thinks this explanation unsatisfactory,—the complement added is in no way known or estimated. Some workers dry the complement on filter paper,—this must be inaccurate. It is true some methods attempt evaluation of complement, but the process is lengthy and the estimation is probably of little use the next day. Emery uses unheated serum and fully sensitised human corpuscles,—this will work with even a trace of complement.

From results it is clear that the presence of large amount of complement does not vitiate results. The hæmolytic system is simply an indicator analogous with the use of litmus in titration. Emery objects to the use of sheep's corpuscles. Amboceptor is not always present (or not in sufficient quantity, in human serum to link up with its complement to these corpuscles. Hence non-syphilitic serum has to be added, but the *amount* to add is not easy to say. *Human* corpuscles are used in Tschernugobow's, Noguchi's, Birt's and Emery's processes—they involve the use of an immune serum to supply the necessary amboceptor to link up the pre-existing complement.

Emery's Method is as follows:—Prepare an emulsion of sensitised washed human corpuscles by adding 1 volume of corpuscles to 4 volumes of heated immune serum from a rabbit which has been injected with human corpuscles. This serum must be strong enough to sensitise the corpuscles to a trace of complement, and not strong enough to clump them instantly. The dilution is found experimentally and the serum diluted accordingly. Enough of this 20% emulsion of corpuscles is prepared to last for about 20 tests. The mixture is incubated a few minutes to allow of the linking up of the amboceptor and is then ready for use.

In the test 1 part of serum to be tested is mixed with 4 parts of Saline Solution (about 5 C.mm. in all by means of Wright's capillary pipettes) Place in water bath at 38° C.; next a mixture with diluted antigen in the same proportion is placed alongside,—this being the test, the other the control. Other sera to be tested can be placed alongside in the customary manner. The combination takes place in five minutes or less—there is no need to wait the customary hour. Next add 1 volume of the Emulsion of sensitised corpuscles to each tube—mix up thoroughly. If the balance between amboceptor be right, the corpuscles in the control will be dissolved before they have time to settle, and if not they must be stirred once or twice,—the actual 'test' tubes being treated likewise. In a few minutes the results can be read. In a *negative reaction both tubes show hæmolysis*, complete or nearly so; in a *positive one the first tube only* shows it, whilst in the latter the corpuscles will settle leaving a colorless supernatant fluid. With regard to **Standardisation of Antigen** this should be compared with *normal* not with syphilitic serum. Emery advises and *suggests as standard* the use of an extract of such strength that when diluted 10 times its volume it exerts a definite inhibiting influence on a normal serum, but does not cause complete inhibition except in a small proportion of cases.—*Normal Human Heart Muscle* is used. The extract is prepared 1=1 with Absolute Alcohol (see paper, L. i./ix, p. 567, for details), also for details of the Quantitative Method to which justice cannot be done in a short abstract.—L. ii./io, 732; i./ii, 564, 594.

W. D'Este Emery provides further details of his method, which he says is as accurate as it is possible to make it.—L. ii./12, 183.

The Latapie Method employs Antigen of hereditary syphilitic liver and human complement, or when latter deficient guinea pig serum. It is conducted on the recognised lines. The Antigen is supplied in tubes. It is diluted 22—26 times according to indications.

Parasyphilitic Conditions In Relation to the Reaction.

Parasyphilitic conditions, as instanced by tabes and general paralysis vary somewhat. General paralytics give positive results in every

case,—tabetics do not give it in more than 60%.—B.M.J. i./09, 1238; ii./09, 984; L. i./09, 1457, 1512.

Cytodiagnosis, lymphocytes markedly increased in 80 progressive parasymphilitic affections.—Mott. L. i./09, 489, 1354, 1666; B.M.J. i./09, 1408.

Differential diagnosis of syphilis and parasymphilis of the nervous system. The doctrine has been put forward that "general paralysis is, like tabes, a consequence of syphilis, and that the two diseases are so similar in their etiology that they might probably be regarded as one disease affecting different parts of the nervous system." Others have said that "General paralysis is the product of syphilisation and civilisation." Practically every case of general paralysis gives a positive lymphocyte and a positive Wassermann reaction.—F. W. Mott. B.M.J. ii./11, 1337; L. ii./11, 1392.

Syphilis of the nervous system. The cerebro-spinal fluid of 127 cases of varied forms of insanity examined for Wassermann Reaction. 64 of these were general paralysis, and in 59 or 92.1% a positive result was obtained. 21 of the 59 since dead from general paralysis.—Mott, P.R.S.M., Neurol. Sectn., Feb. '10, p. 35 *et seq.*

The reaction is one of the most reliable and valuable tests for general paralysis. A positive reaction was obtained with the cerebro-spinal fluid in 90% of cases. The Liver Extract was made in this investigation slightly different from the original. The liver was reduced to an anhydrous powder by mixture with Plaster of Paris and silver sand—then washed with Acetone and finally extracted with cold alcohol,—this was thought to eliminate substances adversely affecting the test.—L. ii./11, 1320.

The spirochete of syphilis, it is stated, actually flourishes in the brain in general paralysis and is present in, at least, "some cases of locomotor ataxia.

Of 204 idiots examined in America 30 or 14.7% gave the + Wassermann Reaction. Roy. Soc. Med., Debate on Syphilis.—B.M.J. ii./12, 70.

Mental Disease, 150 cases.—In a number of cases of general paralysis the blood and cerebro-spinal fluid may give a negative Wassermann reaction even on repeated examinations. This does not agree with McIntosh and Filde's statement that "a negative reaction in serum in a suspected case of general paralysis will render this diagnosis improbable"; and "a negative reaction in the cerebro-spinal fluid of a general paralytic is unusual." A negative Wassermann reaction is more likely to be obtained in the case of a female general paralytic than of a male. The blood is negative rather more often than the cerebro-spinal fluid in the case of male patients, but the reverse obtains in the case of female patients. At least 0.1 Cc. of serum should be used for the test, and, where practicable, 0.2 Cc. should also be used. At least 0.5 Cc. of cerebro-spinal fluid must be used, if possible also 0.8 Cc., otherwise positive results may be missed. Practically the original Wassermann Test employed.—David Nabarro, B.M.J. ii./12, 1454.

Routine cerebro-spinal fluid examination in diagnosis of nervous disease. Cell counts, Protein content, Wassermann Reaction, Colloidal Gold Test.—A. Douglas Bland. L. ii./20, 637.

Lange's Colloidal Gold Test see p. 395.

General References to the Reaction.

In cardiac disease. Positive reactions seemed to indicate that syphilis is an important factor in the production of cardiac disease.—L. ii./09, 1159.

Ehrlich showed that hæmolytic amboceptors can be developed in the serums of animals injected with the red corpuscles of other animals of the same species. Experiments by Batty Shaw show that it is possible to develop in

the serums of animals into which injections have been made of the organs of another animal of the same species, in part at least an increase of the hæmolytic power of the serum. *Emulsions* of different organs seem to have varying power of checking hæmolytic power of these experimental serums,—kidney emulsion most and liver least.—B.M.J. ii./09,1268.

Wassermann's Reaction with cerebro-spinal fluid. A positive reaction is obtained when the blood or cerebro-spinal fluid causes fixation of complement of guinea-pig serum. A reliable aid to diagnosis.—F. W. Mott, L. ii./10,82.

A large proportion of dead bodies gave the reaction—not necessarily attributable to syphilis. It is not of value on such as diagnostic.—L. ii./10,204.

Blood Serum of Idiots examined.—15% gave the reaction. Not unreasonable to assume a relation between syphilis and idiocy.—L. ii./10,227.

Failures of the Reaction.—Mistakes are more often due to defective system of applying it than to the method itself. Warning against neglecting the clinical symptoms and relying exclusively on the results of the Wassermann's reaction.—L. ii./10,263.

B.M.A. (1910) DISCUSSION ON COMPLEMENT DEVIATION METHODS IN DIAGNOSIS, Prof. Wassermann's paper—B.M.J. ii./10,323,1427. H. W. Bayley on the practical value of the reaction, *ibid.*, p. 1430. R. Muir on Fixation of Complement in general *ibid.*, p. 1430. J. Henderson Smith on the Structure of Complement in relation to deviation, *ibid.*, p. 1433. T. W. Bassett Smith on Diagnosis by Complement deviation, *ibid.*, p. 1434. Ivy McKenzie on Individual properties of Complement and organ extract, *ibid.* p. 1435. H. R. Dean on comparison of the Original Method with some of its Modifications, *ibid.*, p. 1437. L. W. Harrison on Guidance afforded, *ibid.*, p. 1438. C. H. Browning on Lecithin and Cholesterin as Reagents, *ibid.*, p. 1439. J. O. W. Barrett on Complement Deviation in relation to carcinoma, *ibid.*, p. 1440. Leader, *ibid.*, p. 1450.

Useful in determining the specific nature of atypical lesions,—*e.g.*, apparently non-syphilitic soft sores, of extragenital sores and of manifestations of the disease where primary and secondary symptoms had been suppressed. As a means of diagnosis the reaction is supplementary to the examination for spirochetes, and where these are scanty, as in tertiary lesions, it is available alone.—L. ii./10,1491.

In 5 cases of phthisis the only sign of syphilis was a + reaction discovered after death. At the necropsy the condition of the lung was suggestive of old syphilis. This seemed to support the view that syphilis affecting the lungs predisposes to phthisis. Post-mortem examinations in general give a correct diagnosis in non-syphilitic cases. As a rule if the reaction is + during life a syphilitic area will be found post-mortem.—B.M.J.E. iii./10,20, *q.v.*, for further data on these lines.

Association between syphilis and cancer of the stomach. The surgeon should avail himself of the Wassermann Test before exploring the upper abdomen. Syphilis is stated to be a commoner cause of disease than is at present recognised. A not inconsiderable number of cases simulating cancer of the stomach are thought to be the result of syphilis.—B.M.J. ii./10,952.

Boas records 1064 control observations on normal individuals and on cases of other diseases than syphilis. Of these only one case,—one of scarlet fever—gave a positive reaction. In countries other than tropical ones the reaction is specific. He regards the test as not infallible in the first stage of syphilis. In secondary and tertiary syphilis it is infallible provided patient has not previously undergone any treatment. The reaction in general is far more marked in cases which have not been treated than in those that have. In latent syphilis only a + reaction can be taken as of any diagnostic value. In general paralysis of the insane a + reaction occurs constantly with serum, also almost always with the cerebro-spinal fluid.—L. ii./10,1705; B.M.J. i./11,1432.

Comparative value of the various methods of antisymphilitic treatment as estimated by the Wassermann reaction. Salvarsan first, inunction or intramuscular injection of insoluble Mercurials second, Mercurial Pills and Suppositories a "bad third."—L. ii./11,1332.

The fallacy of the Wassermann Reaction is that when it ceases to be positive in the secondary stage it does not signify that the syphilis is cured, but only that Sp. Pallida has retired from the blood, into the tissues from which they may merge later and give rise to fresh symptoms.—L. ii./13,1225.

Significance of the Wassermann Reaction in gynæcological practice. In gynæcological ailments, especially those associated with uterine hæmorrhage,

syphilis, it is stated, is very frequently present. Whenever there is metro-rhagia or menorrhagia apart from obvious cause, such as tumour, syphilis should then be suspected.—B.M.J. ii./13,1003.

Prostitutes—104 girls aged 14 to 18—half of whom resided in the poorest quarters, while the other half lived in the best districts,—all showed a + Wassermann reaction. Apart possibly from a certain proportion of congenital cases infection must have taken place recently and, therefore, all must have been in a highly infective state. Syphilis and the health of the community.—C. H. Browning, B.M.J. i./14,77.

Blood of 491 healthy persons examined. 46 or 9.36% gave a positive reaction. Prevalence of venereal disease indicated seems higher than might have been expected.—Sir John Collie, B.M.J. i./16,346.

Method of procedure for large number of tests.—P. Fildes and J. McIntosh L. ii./16,751.

Surface Tension due to the alcohol used in making the Antigen thought to be the important factor in the Wassermann Reaction. The Alcohol itself is the Antigen.—V. B. Nesfield, L. i./17,18.

A quick method of performing with small quantities of serum.—F. E. Taylor, L. i./18,19.

Use and abuse of the test. Protests against the acceptance of a positive reaction in the absence of other evidence of syphilis.—H. W. Bayly, L. i./18, 632.

Doubts as to value of the reaction. Because the Complement Deviation Test may be + it is inaccurate to say the case is syphilis.—A. S. Leyton, B.M.J. i./18,523.

Important principles connected with the Test. The addition of a little Cholesterin to the ox liver extract is important. The 'Standard Antigen' made up according to directions (L. ii./16,751) is now generally used. A dilution of 1 in 15 is found best.—J. MacIntosh, L. i./13,630,641.

Parenchymatous syphilis. Biological characters of *Sp. Pallidum*.—F. W. Mott, B.M.J. i./15,194.

Influence of Drugs on the Reaction.

In two lectures on 'Recognition, Treatment and Prophylaxis of Syphilis,' Major French deals with all the recent developments. Effects of treatment on the Wassermann Reaction by Mercurials, Salvarsan and Iodide are specially entered into. The value of the Wassermann Test as diagnostic is most critically surveyed.—L. i./11,1315,1316,1386.

Potassium Iodide and the early Arylarsonates (Atoxyl, Soamin and Orsudan) seem to have little, if any, action on the Wassermann reaction. Tables showing effect of treatment by intramuscular injections (Mercury) and '606.'—H. W. Bayly, Q. Jl. Med., Jan. 1911, p. 233.

Congenital Syphilis irrespective of treatment, tends to give a + Wassermann Reaction, which is not altered, however much Mercury is given—McDonagh, P.R.S.M.—Nov. 1910, Otol. Sectn. p. 22.

Emery finds that in the early part of the primary stage a — result is of value, but a reaction may be expected if the supposed chancre has been present for six weeks or more. Children and adults with hereditary syphilis usually give strong reactions. In the later stages if the reaction is present the patient is not cured. If there is no reaction it is difficult to decide, but if a reaction has been present, and is subsequently, the probability of cure is great, but **Mercury itself inhibits the reaction.**—L. i./11,595.

Casoni took sixteen individuals, twelve of whom were definitely non-syphilitic, and four suffering from syphilis, and observed their reaction to the test before and after giving the following drugs: Iron Citrate, Sodium Arsenate, Strychnine, Guaiacol, Sodium Glycerophosphate, and Quinine. In the twelve non-syphilitic cases the Wassermann reaction was negative both before and after treatment. In the four syphilitics one remained unaffected by treatment, the reaction being positive all the time. Of the remaining three, in one the reaction disappeared completely under arsenic, and in the other two it was much less marked. Quinine abolished it entirely in one, while it did not modify it in the others. It was only the quinine and arsenic which modified the reaction, and this not in every case. Iron, Strychnine, Guaiacol, and Glycerophosphate had no effect in this respect.—B.M.J.E. i./11,24.

Provocative Test.—Patients giving negative Wassermann Reaction will yield a positive reaction after a Salvarsan injection.—Wyatt Wingrave;

Serum for Examination, transmitted from abroad must be collected, under aseptic precautions, transferred to a sterile vessel, inactivated at 56° to 60° C. for $\frac{1}{2}$ hour and sent in cold storage.—B.M.J. ii./10,240. *Or proceed thus:*—

Examination of Dried Serum.—The blood is collected in the usual way in a bent Wright's tube, and allowed to coagulate. A definite quantity of the Serum is pipetted off and allowed to dry on blotting paper. This can then be treated with Normal Saline and made up to its original volume for conducting the test.

Hermann-Perutz Reaction.

Solution No. 1 Sodium Glycocholate 2 Gm., Cholestrin 0.4 Gm., in 100 Gm. of 95% Alcohol. To be diluted with 20 parts of water before use. Solution No. II. 2% Aqueous Solution of Sodium Glycocholate.

The test consists of inactivating the Serum to be tested at 55° C., for half an hour and to 0.4 Cc. of this, adding 0.2 Cc. of Solutions No. I. and No. II. A flocculent precipitate forming at ordinary room temperature indicates + reaction. Supported by Wassermann results.—B.M.J.E. ii./12,52.

McDonagh's Syphilis Test. Thorium Nitrate and Sulphate and Lanthanum Sulphate are used.—M.P.C., June 28/16.

GENERAL REFERENCES TO SYPHILIS.

Syphilis.—History of, on the Wassermann Reaction and Parasyphilis and on treatment. Permanent cures known of Mercurial treatment. Need of a system of registration of syphilitics in the United Kingdom, and of instructing the public.—Sir H. Morris, L. ii./12,497

Cattle are immune to *Sp. pallidum*.—Boxwell, Dublin, Jl. Med. Sci. Dec. 19.12.

Royal Commission on Venereal Disease.

The paper deals with: Syphilis of the innocent; is syphilis increasing? Modifications of syphilitic phenomena, Notification and regulation, and the example of Australia.—Sir Malcolm Morris, L. i./13,1817.

The pressing need of the inquiry. Legislative reform urgently needed.—Editorial. L.ii./13,1128.

The danger of syphilis to the community and the question of State control.—H. C. French, L. ii./13,990.

Evidence by Sir V. Horsley and Dr. Florence Willey.—B.M.J. i./14,923.

Prevalence, Effects, Diagnosis and Treatment, Notification, Treatment by unqualified persons, Marriage and Communication of the disease. 10% of the whole population in large cities is affected with syphilis and the percentage with gonorrhœa must greatly exceed this.—B.M.J. i./16,346,380.

Sir William Osler's Lettsomian Oration of the Medical Society of London. Syphilis the despair of the statistician. No trustworthy data. Even in death a stigma is associated with it, and the returns were everywhere but under the special caption of the disease itself. In the case of the Gonococcus this organism is not a destroyer of life, but the greatest known preventer of life. Of 1,885 deaths stated to have been caused by syphilis in the Registrar General's Report for 1915, 1162 were under 1 year, 1277 under 5 years. In 1915 of 800,000 children born 90,000 died within the first year. The number of these deaths from syphilis was probably between 15,000 and 20,000. Description of the Work of the National Council for combating Venereal Disease, 1914.—B.M.J. i./17,694.

Venereal disease in the Army. Sound advice. The work of the Association for Moral and Social Hygiene. The removal of prostitutes from areas of large camps.—L. i./16,305.

Antivenereal Campaign in Germany.

The German Society for combatting venereal diseases founded by Professor Blaschko and Neisser in 1902, has made enormous progress. Over six million warning leaflets suited to either sex have been issued by the Society, —they are designed to throw light on the hidden dangers of loose living. The information is compressed into ten short rules, which can be digested by the least intelligent and which are designed to contradict certain popular fallacies, as for example, that it is harmful to a man's health to abstain altogether from sexual intercourse.—B.M.J. ii./13,1174.

Query's Serum.—Dose.—Injection, subcutaneously or intramuscularly of 25 ampoules one a day for 25 consecutive days, ordinarily it is not neces-

sary to renew the treatment. This preparation is made by immunising animals with a 'polymorphous bacterium' isolated from a syphilitic affection. The animal employed is the monkey, as this animal presents a natural resistance to syphilitic affections. Normal serum of monkeys gives a negative Wassermann reaction, whilst the serum of monkeys which have received injections of toxins gives invariably positive.

The Serum is obtained from the carotid of the animal without added preservative. It forms a yellowish liquid, becoming turbid at 45° and coagulating completely at 75° to 80°. It is not to be exposed to temperature above 40° to 45°, which destroys all or part of the antitoxin.

For a patient above ordinary adult weight a larger quantity of the serum than 25 ampoules will be necessary, on the other hand for children 15 to 20 ampoules ought to be sufficient. Syphilitic affection of old standing may well have series of 10 injections after three or six months. Said to be harmless and not painful. Slight local erythema may occur, which disperses in 40 to 48 hours. Ampoules which are turbid are not to be used. Also supplied in *dry form*, each vial of dry serum corresponds to an ampoule of the liquid,—dilutions being made with cold boiled water.

Relief of symptoms very marked.—J. Dobriansky, J. H. Sequeira and T. Thompson, L. i./20,903.

Tick Fever.—Muir and Ritchie state the so-called African tick fever has been shown to be caused by a Spirochete of closely similar character to that of relapsing fever, but bacteriologically it is more convenient to keep the two diseases separate,—associating tick fever with *Sp. Duttoni*. Dutton and Todd in the Congo Free State also Greig and Nabarro in Uganda, 1903, and Milne and Ross in 1904, worked especially on this subject. Clinically the fever closely resembles relapsing fever, but the periods of fever are somewhat shorter—rarely lasting more than two or three days. The organisms are much fewer in the blood than in the European relapsing fever. Morphologically they are almost the same.

Sp. Duttoni can be maintained virulent for wild mice in artificial media for 40 days. It will multiply and can be successfully transferred in artificial media—Egg Yolk in mouse decoction was the most successful medium.—L. i./09,834.

Through the bite of ticks from Nyassaland, collected in the hut of a native in whose house cases had occurred, Leishman was able to infect a monkey. The spirochetes appeared in the blood of the animal on the sixth day and it died on the thirteenth day. From the monkey, transmission had been possible to mice.—B.M.J. ii./08,1435.

Sp. Duttoni—the parasite of Tick Fever. Experimental investigation.—Sir W. B. Leishman, L. ii./20,1237.

Trench Fever.

A report to the Medical Research Committee on Trench Fever limits this to a definite clinical entity with peculiar temperature course, slow pulse and pain. A recurrent fever with a cycle of about 5 days. It should not be extended to cover any 'P.U.O.' It is an infectious disease. Not fatal. Tends to slow but spontaneous cure. No drugs of avail. Conflicting evidence as to etiology and transmission. Considerable bibliography.—C. E. Sundell & A. T. Nankivell, L. i./18,399.

Strong grounds for believing that infection is derived from the contents of the alimentary canal of the louse. Experiments on volunteers at the Hampstead Military Hospital under the charge of Major Byam showed that the *excreta* of infected lice scratched into the skin produced typical Trench Fever in an average of eight days.—Sir D. Bruce, Committee on Trench Fever, B.M.J. i./18,88,353,354. See also Sir W. Herringham, B.M.J. i./19,20.

Major Byam's report on—the moral is 'Kill the Louse.'—B.M.J. ii./19,345. Filter passing virus in. Minute coccus-like bodies in pairs Gram positive 0.3 to 0.5 μ . Recovered by culture in 11 out of 15 cases in the pyretic stage and in 3 out of 8 when apyretic. Found in the blood and in louse excreta.—Sir J. Rose Bradford and co-workers, B.M.J. i./19,127.

Criticism of claims as to the filter passing virus of T. Fever and Influenza.—J. A. Arkwright, B.M.J. ii./19,233.

Agglutination experiments with Trench fever Rickettsia. —J. C. G. Ledingham, L. i./20,1264.

Clinically the tongue is characterised by a red margin $\frac{1}{4}$ to $\frac{1}{8}$ inch wide with thick and bright yellow fur covering the rest. Headache, pain in the lower part of the back and second or third day in the legs—"Trench Sain." Sequelæ: anæmia and disordered action of the heart. Considerable details on the affection.—E. R. Grieveson, L. ii./17,84.

Treatment:

Aspirin the most effective analgesic. Quinine has no obvious effect. Quinine bihydrochloride 10 grains subcutaneously when temperature rises above 99° puts an end to relapses in prolonged cases. Eusol intravenously given without success, also the serum (20 Cc.) of a convalescent patient given without influence on the course of the illness.

Locally Magnesium Sulphate (saturated solution) as cold compress.—Maj. A. F. Hurst, L. ii./16,671.

Vinum Colchici has distinct value in dealing with the troublesome shin pains.—W. Gordon, L. i./18,467.

Other Theories:

ENTEROCOCCUS.—A lanceolate Diplococcus (+ Gram staining) in this and allied conditions present in 18 per cent. of the urines examined and in 16 per cent. of the blood specimens, and in 41% of infected wounds. The organism is a constant inhabitant of the normal bowel. It is remarkably resistant to heat. An emulsion in broth of same will stand $1\frac{1}{2}$ hours at 55° C. This forms the basis for isolating the organism (1 hour at the temperature in question for emulsions of material—pus, fæces or sputum in broth with subsequent plating out of loopfuls on Conradi-Drigalski medium). Grows on all laboratory media both aerobic and anaerobic. Vaccines $2\frac{1}{2}$ millions or less used as a diagnostic method. The effect of inoculations enabled investigators to determine whether the *enterococcus* was the infecting organism. Therapeutic dose, 1 to 20 millions.—T. Honslau & J. M. McCloy, L. ii./16,632.

French writers hold the *Enterococcus* to be a normal inhabitant of the intestines, especially common in the intestines of infants. A German worker, however, does not support the view that it is usually found in the mouth or gut in healthy adults.

R. Donaldson finds it frequently associated with morbid processes especially intestinal. Often found during or after typhoid infections. Non-motile Gram + Diplococci or in short chains. Resemble pneumococci in suggestion of a capsule. Pleomorphous according to time of growth on glycerin agar, etc. Cultural characters with sugar reactions described. It is probably only a variant of the *Strepto faecalis* group.—B.M.J. i./17, 188.

A Spirochete found in the urine.—A. T. Nankivell and C. E. Sundell, L. ii./17, 672. See also A. C. Coles, L. i./19,375.—Spirochetes in the blood.

A hæmogregarine found in the venous blood a day or two before the onset of pyrexia.—L. Dimond, L. ii./17, 382. Presence doubted.—G. C. Low also C. Dobell, *ibid.* 473.

Bluish-purple bodies found lying upon the blood cells or free in the plasma also in Cultures from the blood and fragments of periosteum, fascia or muscle excised from cases. The organism is not bacterial. Provisionally assigned to the genus piroplasma.—A. M. Pappenheimer and co-workers, B.M.J. ii./17, 474.

Trypanosomiasis or Sleeping Sickness.

The disease is endemic on the West Coast of Africa, notably in the Congo Basin. It is believed to be caused by the entrance into the blood and cerebro-spinal fluid of the parasite *Trypanosoma Gambiense*. It causes a complete dislocation of the brain functions, slow inflammatory process goes on in the brain cells for years, gradually the individual becomes languid in the extreme, he has not physical energy enough to walk, speak, or even feed himself. The trypanosome of Gambia was first named and described by Dutton, who lost his life in 1905 in West Africa whilst engaged in his work

on this disease. The blood or cerebro-spinal fluid of an infected person has been injected into a monkey with result that the animal died with all the symptoms of sleeping sickness. It is transmitted from the sick to the healthy by a tsetse fly (*Glossina palpalis*) and not by other biting flies (*Stomoxys*). In the stomach of this fly the trypanosome multiplies by fission. The parasite was discovered by Castellani in Uganda, but an Englishman, Adams (1901) first entertained the idea that sleeping sickness was caused by Trypanosomes. For research work see B.M.J. ii./11, 285, 1028, 1263; L. ii./11, 459. For work regarding advised extermination of big game, etc., see p. 535 and 536.

The condition known as sleeping sickness may be regarded as the terminal stage of trypanosoma infections. The average duration is 4 to 8 months. Mania is not uncommon. Blood or gland-lymph examination, or if this be negative hepatic or spleen puncture should establish diagnosis. General paralysis of the insane, cerebral tumour, forms of meningitis have features in common. The Wassermann Reaction is of little avail as the sera of most cases give a positive reaction.—Manson.

Sir David Bruce classifies African Trypanosomes pathogenic to man and animals on morphology, pathogenic action on animals and mode of development in the insect host. With exception of *T. evansi* and *T. equiperdum* all are carried from sick to healthy animals by tsetse flies. The first of the three groups into which they are divided includes *T. brucei*, *T. gambiense*, *T. evansi*, and *T. equiperdum*. The second comprises *T. pecorum* and *T. simiae*. The third embraces *T. vivax*, *T. caprae* and *T. uniforme*. The development of the first group begins in the intestines of the fly and ends in its salivary glands. In the second it begins in the gut and ends in the proboscis. In the third the whole development is limited to the proboscis and does not occur at all in the intestines of the fly.—L. ii./14, 1373; P.J. i./15, 33. See also Croonian Lecture, L. i./15, 1323 (a very concise account both of the Trypanosomes and Tsetse flies. In addition to *G. Morsitans*, the carrier of *T. brucei*, there are now some 13 different species. The antelopes on the shores of Lake Victoria act as a reservoir of the virus of sleeping sickness, hence the flies have retained their infectivity in spite of removal of the native population). L. ii./15, 1 (Description of Nagana and differentiation of Nyasaland sleeping sickness from that of the Congo. *T. brucei* is responsible for Nagana and *T. rhodesiense* is identical with it). L. ii./15, 55 (Description of the Congo sleeping sickness). L. ii./15, 109 (Description of *T. pecorum* and other types which so far as is known do not attack man).

See also Trypanosomes, Some remarks on Classification, by H. M. Woodcock, L. i./20, 462.

If Tsetse flies were "successfully" introduced into India sleeping sickness might appear there in due course.—Manson.

Mott gave some analogies between trypanosomiasis and syphilis. Possibly the fashion in which the two organisms (*T. Gambiense* and *Sp. Pallida*) originally invaded man was the same. *T. Gambiense* can

usually be found in the blood with ease, *Sp. Pallida* cannot, and seems able to multiply only in lymph spaces and channels. Possibly the deadly results of infection with *T. Gambiense* as compared with other trypanosomes is due to *T. Gambiense* having acquired the habit of migration into the subarachnoid space.

As to Organic Arsenic bodies Mott thinks possibly the trypanocidal and spirilloidal action due to their stimulating phagocytosis,—possibly to their having an affinity for the phosphorus-containing lipoids of the periplasmic membranes of the organisms in question. Toxic effects of Organic Arsenic Compounds on the other hand may be due to its union with the lecithins of the nervous system. Patients, therefore, seem to stand between the devil and the deep sea.—B.M.J. ii./10, 1647.

Spirochetes are generally believed to be linked to the protozoa rather than to bacteria. A Spirochætal invasion clinically differs from a bacterial one and conforms especially to certain trypanosome infections and there is great similarity of the histological lesions of the nerve tissues of chronic trypanosome infection,—e.g., sleeping sickness and the *mal de coit* (Dourine) of horses (transmitted by *T. Equidermum*)—to syphilitic and parasyphilitic lesions. There is further similarity in the fact that lymphocytes and plasma cells are found in the cerebro-spinal fluid in trypanosome diseases of animals and man, e.g., sleeping sickness.

Sp. Pallida though now transmitted direct from man to man was possibly at one time dependent upon a biting insect just as now is the Spirochete of tick fever.

One essential difference in effects on the nervous system between *T. Gambiense* and *Sp. Pallida* is that whereas every case of this trypanosome infection leads finally to invasion of the nervous system, yet in syphilis not more than 5 or 10% even of untreated cases do this.

Trypanosomes are always found in the cerebro-spinal fluid. Spirochetes have never been demonstrated in it.

T. Gambiense is the special organism of sleeping sickness whether acquired in the Congo State, or any other portion of Africa. Europeans are just as easily attacked as the natives. It is very doubtful whether the Organic Arsenic Compounds, Mercury, Trypan Red, etc., though causing the trypanosomes to disappear from the blood, will attack same when once in the cerebro-spinal fluid, as these drugs do not pass from the blood into the cerebro-spinal fluid. Various workers have suggested that the trypanosome may pass into *latent* endocellular form.

Some experiments on clearing the natives from the shores of Victoria Nyanza were thought to prove that *Glossina Palpalis* retained its infectivity for a period of two years, but there may be numerous means of re-infection of the flies.

Clinical Study and Pathological data of Human Trypanosomes, *vide* Mott.—P.R.S.M. Path. Sect. Nov. '10, p. 1, *et seq.* See also B.M.J. ii./17, 104.

Spirochetes have been regarded as primitive or transitional forms leading up from the bacteria and their allies to the flagellates. Involution Stages of Trypanosomes.—Na. Oct. 1911, 575.

Research was instituted by arguing from analogy with the Tsetse-fly disease in cattle. It was found that *Glossina palpalis* can carry the disease for a period of 48 hours from the sick to the healthy.

The *glossina* must be exterminated, but in addition immunisation experiments have been undertaken, the principle being to pass a strain of trypanosoma through different races of animals until a certain degree of virulence is lost. Laveran has made preliminary attempts by means of horse serum. A similar process was carried out by Koch with success in the allied Indian disease in horses—surra.

The condition of the stomach in sleeping sickness is a marked feature. It is comparable with the petechial hæmorrhages met with under the endo- and epicardium of the heart in other trypanosomic affections.—L. ii./05, 1909.

Nabarro and Greig showed sleeping sickness can be conveyed by other species than *glossina palpalis*.

Meat is one of the cravings of the sufferers. Of 300,000 round the Victoria Nyanza 200,000 were swept out of existence.

Hodges does not see any need to suppose the existence of any other means than *Glossina palpalis* of spreading the infection amongst human beings.—Sleeping Sickness Bureau, London, L. i./09,483.

Examination of infected villages showed that '*palpalis*' villages are more heavily infected than the '*morsitans*.'—B.M.J. i./09,403.

Serum Therapy suggested.—i.e., the injection of a highly immune serum obtained from the blood of patients recently recovered,—or rather, as these are few and far between, of patients subjected in the first instance to chemotherapy (Atoxyl, &c.).—L. i./09,716. The injection to be intra-spinal—the serum could be taken from a patient improving. The blood of those suffering from trypanosomiasis contains trypanocidal bodies—the intra-spinal treatment could be combined with chemical treatment through the blood.—B.M.J. i./09,1176.

If a fly, three weeks after feeding on an animal suffering from sleeping sickness, were incapable of giving infection, trypanosomes were not found in its stomach. Further trypanosomes were not found in flies which had been kept from infection, nor in flies fed on healthy monkeys.—B.M.J. ii./09,903.

Bagshawe on advances made during 12 months prior to Oct. '09, in prevention and cure of sleeping sickness. Kleine showed that it takes about 20 days in the case of *T. brucei* after the fly has ingested the trypanosome before it is capable of infecting susceptible animals. Bruce confirmed this for *T. Gambiense*. Some flies probably remain infective for the rest of their lives. Bruce introduced fluid swarming with trypanosomes from the gut of a fly, fed 75 days before on an animal infected with *T. Gambiense* and subsequently on healthy animals,—into a monkey. After 8 days the monkey became infected. This indicates some form of development, whether a sexual process or merely multiplication as seen in cultures is not known. Sleeping sickness does not become endemic except in districts in which *glossina palpalis* is in evidence. That this fly is a transmitter of human trypanosomiasis has been known since 1903. Sexual coitus has been thought by Koch and Kudicke to explain the occurrence of the disease in *palpalis*-free areas. The suggestion that other "auxiliary" flies are responsible in addition is refuted. Diagnosis by direct examination of the blood gave a large percentage of successes, particularly on centrifugalising as also the examination of the glands, cervical and submaxillary, in particular. Gland palpation is employed in preliminary diagnosis. A single dose of Atoxyl will cause marked retrogression in the size of infected glands—the larger the glands the more likely the existence of trypanosomes within. In the matter of symptoms it would appear that paralysis, paresis, and epileptiform convulsions, which among untreated cases, occurred in small percentage, are now commonly met with, and are often followed by sudden death, which was very exceptional before the use of Organic Arsenic.

Sudden or rapid death was frequently the termination of cases of sleeping sickness treated with full courses of Organic Arsenic.

There are indications that nature is working out a cure for herself by attenuating the virulence of the trypanosome, or by some other factor or combined factors.—L. ii./09,1193; B.M.J. ii./09,767; see also JI. Trop. Med., Nov. 15, 1909.

The following notes are taken from the "**Report on measures adopted for the suppression of Sleeping Sickness in Uganda,**" by Sir H. Hesketh Bell, K.C.M.G., being Parliamentary Colonial Report, No. 63 Uganda.

The disease appears to have come from the Congo basin. At Kampala in 1901 eight cases of a mysterious disease were first noted.

The total mortality in the Uganda Protectorate from the scourge up to end of 1906 considerably exceeded 200,000. A number of investigators were sent out by the Royal Society. Koch, who arrived in 1906, devoted himself to curative methods, using Atoxyl in particular in large and repeated doses. The method seems hopeful, but in view of the protracted duration of the disease, and variety of the phases, some years would have to elapse before any cure could be considered permanent. The disease so far appears to be incurable. The best recommendation seems to have been to remove the entire population to fly-free areas. Citronella plantations are in a flourishing condition, and probably drive away several kinds of noxious insects, but they have been disappointing (p. 52). The segregation camps justified existence in several particulars. Drugs have prolonged lives, but not a single undoubted cure among thousands of cases that have passed through the camps.

In February, 1909, Kleine stated that the trypanosome must pass through a cycle in the fly of at least 17 days, and until this had happened it was unable to transmit the disease. He proved flies capable of conveying infection up to the 75th day. Bruce later found *Glossina palpalis* capable of retaining infectivity for two years.

B.M.A. DISCUSSION ON TRYPANOSOMIASIS.—There is no absolute proof that a single person had recovered from sleeping sickness. There were some 49 cases among Europeans between 1908 and 1910,—in Europeans chance of recovery is greater than in natives. It is difficult to understand how the flies retained infectivity for two years after the native population had been removed from the shores of the Victoria Nyanza. Possible explanations are given. Experimental injections into Hippopotami, etc., negative so far. With regard to epidemiology, possibly a considerable degree of saturation with *Glossina* is necessary before an epidemic spread of sleeping sickness takes place. With regard to possibility of hereditary transmission of *T. gambiense*, *T. brucei*, etc., by the respective infected *Glossinae* to their progeny, the majority of experiments so far conducted were negative, but L. W. Sambon still holds this view.—B.M.J. ii./10,864, *et seq*

Eighteenth Bulletin of the Sleeping Sickness Bureau.—It is suggested that *Glossina Morsitans* is harmless to man when occurring on open and relatively high ground, and probably dangerous in the presence of a sleeping sickness "reservoir" when inhabiting damp and warm valleys. Possibly the development of the trypanosome in the body of *Glossina*, which in favourable circumstances is only in about 5% of these flies, does not occur in relative cold or dryness.—L. ii./10,323.

In the **20th Bulletin of the S.S. Bureau** records of 50 cases of Europeans are given,—of these thirty are known to be dead. One of the survivors, infected probably in 1900, is regarded as cured with Fowler's Solution.—Na. Oct. 13/10,469. For recent deaths, *vide p. 536*.

The staying of the disease in Uganda by clearing the Northern shores of Victoria Nyanza of its human inhabitants can only be temporary. The measure is not curative. It will be necessary to determine whether the animals in the district are capable of acting as hosts of the parasite.—B.M.J. i./11,82.

The domestic fowl is not a reservoir for *T. Gambiense*, but the antelope is possibly. Results of a large number of experiments were negative in every case with fowls.—B.M.J. i./11,253.

Experiments on eleven antelopes showed that after tsetse flies had been fed upon them, their blood eight days later transmitted the disease to all the monkeys inoculated, while two-thirds were infected after an interval of thirty days. The antelopes remained in perfect health, although in eight of them trypanosomes appeared in the blood for a few days only. No wild antelope inhabiting the Victoria Nyanza shore has yet been found to be naturally infected. Birds cannot act as a reservoir of the trypanosome.—Sir D. Bruce, Roy. Soc.'s Commission Report. Jan. 1911.

Nyasaland Territories thrown open for shooting game as an experiment to exterminate sleeping sickness.—B.M.J. ii./15,479.

Cold Chamber Treatment.—Results with animals inoculated with *T. gambiense* and *T. rhodesiense* showed advantage of the treatment. The chamber can be kept at any temperature between 15° F. (9.4° C.) and 150° F. (65.5° C.). The cold is produced by an Ammonia Compressor and a fan which drives in air through a chamber in which Saturated Solution of Calcium Chloride is kept constantly trickling over corrugated Iron plates. A sleeping sickness patient underwent the treatment and felt better for it.—B.M.J. i./11, 678.

Trypanosoma lewisi,—the common rat trypanosome, is akin to the Trypanosome of sleeping sickness. The mechanism of infection is the act of *eating* infective fleas and not by being bitten or contaminated by them. C. Strickland.—B.M.J. ii./11,1049.

Contrary to Strickland (B.M.J. i./11,1049) E. A. Minchin and J. P. Thomson bring forward evidence that infection of rats with *T. lewisi* is not in general normally effected through the rat eating fleas,—they believe that the ripe infective form of the trypanosome,—the final form of life cycle which it passes through in the flea,—is regurgitated from the stomach of the flea into the wound made by the proboscis during the act of feeding.—B.M.J. i./11,1309.

T. evansi causes the disease surra in elephants, camels, horses, etc., in India and Africa. The carrier of surra has not yet been identified. There are no tsetse flies in India. Details of differences between *T. evansi* and *T. brucei* are given.—Sir D. Bruce, Roy. Soc. per Na. June 15, 1911, p. 539. See also abstract of this authority's lectures at commencement of this chapter.

T. Cruzi. Responsible for a form of trypanosomiasis especially common in children, endemic in parts of the state of Minas Geraes in Brazil, transmitted by a species of bug *Lamprophya megistus* (called "*barbeiro*").—Manson. See also B.M.J. ii./17,104.

See also *Organic Antimony and Arsenic Compounds* (Vol. I.) for recent treatment and refs.

Trypanosoma Gambiense, Characters of.—Morphologically a long-shaped protozoan containing a large nucleus centrally and a vacuole or contractile vessel at the larger end.

The single flagellum proceeds from a small mass of chromatin at the anterior end. This flagellum forms the edge of undulating membrane which is observable from end to end of the organism, and continues in the same direction for some length as a free tail. It measures 18 to 26 μ by 1.4 to 2 μ .

Analogy has been drawn with certain other flagellates—notably trichomonas, euglena and herpetomonas. Trichomonas move both backwards and forwards, Euglena and Herpetomonas move only forwards, and the trypanosoma backwards—by the aid of the membrane. At the spot slightly behind the vacuole there are some patches of pigment—the so-called eye spots, centrosome or micronucleus.

Trypanosoma reproduces itself by longitudinal division or fission—in addition there is sometimes transverse fission—and formation of rosettes by multiple division. Before the fission there is a division of the centrosome, followed by division of the flagellum, nucleus and the protoplasm—these dividing forms are not easy to find in the blood.

The organism may be found in large numbers in the blood in every case of sleeping sickness, as also in the lymphatic glands and in the advanced disease in the cerebro-spinal fluid.

There is no great reduction in the number of red corpuscles. The hæmoglobin is also not decreased.—L. i./o6,227.

Staining is best conducted with **Leishman's Stain**, *q.v.*; some beautiful specimens can be made with this by first pouring on to the film and allowing to stain half a minute, then add twice the volume of distilled water and allow to stain further half an hour. Wash in distilled water and dry in customary manner.

Other methods of staining are with Thionin Blue, Methylene Blue, and Borrel's Blue, *q.v.*

Manson recommends the examination of the blood when the temperature is high; it is well to centrifugalise as the trypanosomes accumulate in the leucocyte layer above the red corpuscles.—L. ii./o8,991.

Laveran's Method of Staining Trypanosoma.

Prepare thin blood films, and fix in absolute alcohol 5 to 10 minutes. The following are required:—

(1) *Solution.*—Methylene Blue and Silver Oxide (Borrel's Blue). Prepare "some" Silver Oxide freshly by means of Silver Nitrate and Sodium Hydroxide. Wash the precipitate with distilled water thoroughly, and add to it a saturated solution of medicinal Methylene Blue. Allow to remain for a fortnight, occasionally shaking.

(2) Aqueous Solution of Eosin 1 per 1,000.

(3) Solution of Tannin 5%, or, better, a solution of 'Tannin Orange.'

Mix just before use: No. 1 Solution 1 Cc., No. 2 Solution 4 Cc., Distilled Water 6 Cc.

Stain in a flat dish, film downwards, for 5 to 20 minutes—5 to 10 minutes is enough in most cases. Wash in water and treat with tannin for a few minutes. Wash in water and then in distilled water. If precipitate found on the preparation wash in Clove Oil and brush off with Xylol.

Secretary for the Colonies on prevention of trypanosomiasis.—An interesting account. Instead of wiping out the wild animals

which may be source of infection, it is advised to destroy *G. Morsitans*, by cultivating the soil. Heroic measures founded on half knowledge are a mischievous form of human folly.—B.M.J. ii./12,41.

Work by the Royal Commission (c.f. *antea*) in the Luangwa Valley, Northern Rhodesia, has demonstrated that this district is free from *Glossina palpalis* but is infested with *Glossina Morsitans*. This fly is the carrier of *T. Rhodesiense* which is distinguished from *Tr. Gambiense* by the posterior displacement of the macro-nucleus. Approximately 5 per cent. of these flies may become permanently infected and capable of transmitting *T. Rhodesiense* to monkeys and other mammals and presumably to man. The period between the infecting feed and when they become infected is approximately 14 days (minimum duration of cycle in *Gl. palpalis* is 18 days). Certain animals, namely, waterbuck, mpala, hartebeest and warthog were found to harbour a trypanosome indistinguishable from *Tr. Rhodesiense*.

Sleeping sickness in Rhodesia, Nyasaland and adjoining territories is due to *T. Rhodesiense*,—not to *T. Gambiense* recently introduced there.—B.M.J. ii./12,201.

Doubt as to whether the trypanosome found in big game is the same as that known in man as *T. Rhodesiense*. Experiments suggested.—B.M.J. ii./13,150.

Big game, especially antelopes, are the reservoirs of, and *G. Morsitans* is the cause of trypanosomes fatal to men and animals.—A letter in support of extermination.—B.M.J. ii./13,207.

Colonial Office Committee nominated to report on game destruction or other measure to control the disease, *ibid*, 262.

Nyasaland Sleeping Sickness Diary. Deaths during first four months of 1913 totalled 128,—*ibid*, 349. The next eight months accounted for 25 deaths,—*ibid*, 1652.

T. Gambiense and *T. Rhodesiense* not specific to human beings. They can live in various species of antelopes without producing disease in them. Domestic stock also harbour these Trypanosomes. Experiments suggested.—*ibid*, 756.

Identity of *T. Rhodesiense* with Trypanosomes found in game.—B.M.J. i./14,1234.

Blood containing traps suggested for catching flies, as used on the Nile for catching insect pests.—A. Balfour. B.M.J. ii./12,11.

Sleeping sickness on the island "Princípio" off the West Coast of Africa. Appalling figures of death rate. Radical measures under Portuguese Government greatly improved the condition of things.—L. ii./15,238.

Bacillus Tuberculosis.

Relationship between Human and other forms of Tuberculosis.

The Royal Commission on Human and Bovine Tuberculosis in its Reports (1907-1911) found that the human and bovine types are **morphologically indistinguishable**, but cultural characters of the organisms differ, also the pathogenic effects on different animals. The human types grow more luxuriantly, although Bovine Bacilli vary among themselves in luxuriance of growth. *Re* pathogeny, the bovine is pathogenic to cattle, rabbits, goats, chimpanzees, monkeys and pigs, while the human is fatal to guinea-pigs, chimpanzees and monkeys, but causes only slight and non-progressive lesions in cattle, goats and pigs. Possibility of transmuting one type into the other cannot be denied, though experiments for the most part failed. Both types have been obtained in certain in-

stances from the same patient. *The cultural differences are, however, not sufficient to establish the two as distinct organisms. In a considerable proportion of cases of tuberculous disease in man the lesions are caused by bacilli in every respect indistinguishable from the bovine type.*

Mammals and man can be reciprocally infected. Bovine animals are not completely immune to the human type, although they possess a high degree of resistance to it. The bovine has been found in man. The majority of human cases from which bovine bacilli were recovered were instances of tuberculous disease in children. *Infection by cow's milk, beef and pork is possible,—infants and young children are, therefore, specially endangered.* Even in adolescents and adults so large a proportion as 5 out of 55,—the number investigated—showed the presence of the bovine type as to indicate the same source of infection as are possible at other periods of life. —B.M.J. ii./11,122. L. ii./11,166.

The fact is proved beyond question that tuberculous affection of the cervical glands and of the peritoneum in young children is in a large number of cases set up by the bovine type. With regard to infectivity of milk the importance of dosage in the transmission of tuberculosis is brought out. The virulence of the subsequent infection is almost always in direct proportion to the size of the dose administered,—this doubtless accounts for the diminishing susceptibility of the human subject to the effects of the bovine type of disease as age advances,—B.M.J. ii./11,180 (Leader). *Vide also* B.M.J. ii./11,628,634. P.J. ii./11,492.

Prof. Gosio, of Italy, endeavoured to upset the findings of the Royal Commission on Tuberculosis. He claims that where there is much tuberculosis in animals there is little in man and *per contra*, where there is much in man there is little or none in animals. Data are brought forward showing that consumption of European cows' milk is associated with prevalence of tuberculosis in various countries, whilst, *e.g.*, in Morocco, where there are no European dairy cows, tuberculosis is unknown.—B.M.J. i./13,96

Infectivity of Tuberculosis.—Numerous criticisms of H. Batty Shaw's lecture on Pulmonary and other forms of Tuberculosis reported—L. i./20, Jan. 24, are answered by the lecturer—L. i./20, 517: "There are so many good arguments for the theory that the only infection with tubercle bacillus which really matters is the one contracted in childhood that one hesitates to be optimistic as these critics are that segregation will stamp out tuberculosis." One critic (O. M. Holden) goes so far as to prophesy that tuberculosis will in a generation be as uncommon as leprosy. As to cleaning up herds of infected cows the tuberculin test is not satisfactory. Cattle may be tuberculous and yet not give the tuberculin reaction.

Possible Test to distinguish Human and Bovine Types of Tubercle Bacillus.—The rabbit (synovial membrane of the knee joint) is injected with a bacillary emulsion (not mixed infection) or with pus or other pathogenic fluid. By the amount of reaction it is claimed possible to determine nature of infection, *i.e.*, if bovine the changes are rapid and acute, if human the reaction is only slight. The distinction is stated to be clinically and pathologically most striking.—B.M.J. ii./12,1433.

A report on the results of a chemical investigation undertaken by Arthur Harden, F.R.S. (assisted by S. G. Walpole), at the request of the Royal Com-

mission was published as Appendix, Vol. VI., of the final Report of the Commission. It contains a systematic quantitative comparison of the action of the two types, and shows that **no definite physiological difference** has been detected between the human and bovine types of tubercle bacilli. The report contains much bacteriological and chemical detail, and must be consulted by those requiring detail of the investigation.

INTERNATIONAL TUBERCULOSIS CONGRESS AT ROME.—B.M.J. i./12,903,950.

Infection of the human being by the tuberculous cow can and does occur. An answer to "Dangers of Sterilised Milk," by R. Mond.—L. i./14,145.

Portals of entry of the Tubercle Bacillus include, especially in childhood, the respiratory system, alimentary tract, mucous membrane of the nasopharynx, the skin and the placenta—antenatal infection.—Necessity of directing prophylaxis towards suppression of contamination from man to man and principally in the family. Bovine infection is of less frequency.—E. Emrys-Roberts, B.M.J. i./13,210.

TUBERCULOUS MILK, Report on, 20% of samples examined were tuberculous.—B.M.J. ii./14,71. See also G. S. Elliston, B.M.J. i./21,174, and a Leader, "The Milk Supply," showing the unsatisfactory state of control.—B.M.J. i./21,236.

Children and tuberculous milk. Attitude of public authorities—a good letter.—R. Stenhouse-Williams, L. ii./20,869.

Hereditary factor in tuberculosis.—Karl Pearson. L. ii./20,891.

The bovine type is distinctly **more susceptible** to the prejudicial effect of ordinary atmospheric influences (**daylight and drying**) than is the human type of tubercle bacillus. This difference between the types may in part explain why aerial infection with the bovine type is so infrequent in human beings.—L. Findlay & W. B. M. Martin, B.M.J. i./15,110.

Kitasato found that the bacilli ordinarily present in tuberculous sputum are dead even though they continue to stain well.

Tubercle bacilli derived from sputum by cultivation. Of 212 cases of phthisis pulmonalis in England and Scotland, 205 were the standard human type, 4 were atypical human, and 3 standard bovine. Antiformin method used for obtaining cultures. No other investigator in this country has cultivated from tuberculous sputum any but tubercle bacilli of *human type*.—A. S. Griffith, L. i./16,721.

Tuberculosis in Dogs is comparatively rare—it is almost invariably due to infection from a human source. The symptoms—emaciation, loss of strength, etc., are easily recognised.—B.M.J. ii./13,827. On the other hand we read the prevalent opinion that dogs are practically immune to tuberculosis is erroneous. In three years 165 cases were recorded, all being verified anatomically and bacteriologically. The disease is more prevalent among dogs in town than in country districts. Cats also are capable of infection, but are less frequently affected than dogs. Horses seem to be very rarely affected, scarcely one, in 15,000 cases examined, has been recorded.—Cadot, P.J. i./14,287.

Persons of gouty 'diathesis' or of gouty parentage show a marked resistance to tubercle.—H. E. Waller, Pres., Nov., 1913,298.

From a study of the subject in Manchester not less than 25% of the tuberculous children under five years of age suffered from infection of bovine origin and this estimate is much lower than one based on probabilities would be.—Prof. S. Delépine, B.M.J. ii./12,1486.

Hamburger came to the conclusion that 95% of all the children in Vienna aged 15 are infected with tuberculosis, the infection being by aspiration from man to man.

Tuberculosis in infancy. An investigation into the conditions in Edinburgh (371 cases) compared with results of Hamburger and others. Bovine infection in the Edinburgh cases have a considerable share in tubercle infection in that city.—B.M.J. ii./12,677.

In England and Wales in 1909, 10,000 children under the age of 5 died from tuberculosis (other than pulmonary tuberculosis) and it is estimated that 70% of our dairy cattle are affected with tuberculosis.—B.M.J. i./13,96.

Tubercle-Immune Cattle—an attempt to breed, employing Kerry Cattle by crossing with Somerfords.—L. J. Picton, B.M.J. ii./18,157.

In **New Zealand** the control of Tuberculosis is facilitated by the fact that the percentage of animals affected is smaller than in this country, and secondly that tuberculosis had been scheduled as a contagious disease in

New Zealand for a considerable number of years. Dairy cattle are under systematic examination both on import there and in use. Owners of infected cattle are compelled to report suspected disease and compensation is granted for cattle condemned.

Staining Methods for *B. Tuberculosis*:

Ziehl Neelsen method; Sputum and sections.—1. Prepare film from sputum or a section ready for staining, and fix by usual methods. 2. Boil filtered carbol-fuchsin in a test-tube and cover specimens with it entirely; stain films 5 mins., sections 10 mins.

Carbol-Fuchsin Solution, Neelsen's Solution, is prepared by mixing Concentrated Alcoholic Fuchsin *Solution 1 with 5% Carbolic Acid Solution 9, slightly warmed. 3. Wash well in water. 4. Decolourise almost completely by immersing in 25% sulphuric acid. 5. Wash well in water. 6. Counter-stain with

Alkaline Methylene Blue—sputum, 1 to 2 mins.; sections, 3 to 4 mins. This stain is prepared by mixing saturated Alcoholic Methylene Blue Solution 142 mins., with 1 ounce of a 1 in 10,000 solution of Caustic Potash. (Note.—Medicinal Methylene Blue is far more soluble than ordinary and should be used.—W. H. M.)

Carbolised Methylene Blue is also employed:—Dissolve Methylene Blue 1 as much as possible in Alcohol 90% 7, and add Phenol Solution 5% 70, allow to settle and decant. 7. Wash, dry, and mount in Xylol Balsam (sputum). 8. If section dehydrate with alcohol, clarify with xylol, and mount in xylol balsam. If dehydrated with anilin oil instead of alcohol a clearer preparation is produced.

Examine wherever possible the first sputum expectorated after the night's sleep.

Fuchsin-Aniline Green Method for staining *B. tuberculosis*.

Solution A. Fuchsin 10, Absolute Alcohol 100.

„ B. Strong Ammonia Solution, 3, Water 100.

„ C. Water 80, Nitric Acid 20, Malachite or Iodine or Acid Green *q.s.* to saturate. Methyl Green does not give satisfactory results.

Add one part of A to 10 of B. Warm until vapour arises, immerse 1 minute, wash with water, then immerse in C 40 seconds. Wash off thoroughly. Bacilli red on pale green ground.

RECOGNITION.—Delicate, straight, or more usually slightly curved rods. When stained, usually beaded in appearance. The length of the organism is commonly said to be about one-quarter to one-half the diameter of a red blood-corpuscle, but it varies considerably. Involution and branching forms occasionally met with. (Gram +).

The Tubercle Bacillus is about $1\ \mu$ in length when grown on Blood Serum and from 1.25 to $6.5\ \mu$ in the tissues.

Present in large numbers when the process is acute, but are relatively scanty or absent in chronic forms of tuberculosis, *e.g.*, Caseous non-suppurating glands, lupus, &c.

Tubercle Bacilli contained in sputum retain their vitality for a considerable time even when the sputum dries up.

Rosolic Acid Method.—Specially for *B. Tuberculosis* in tissues. Stain in hot carbol fuchsin for 5 minutes. Wash quickly in tap water. Dip five or six times in saturated Alcoholic Solution of Rosolic Acid (Corallin) till fuchsin is removed. Wash in water and counter-stain in saturated Alcoholic Solution of Methylene Blue.

Cultural Characters. *B. tuberculosis* was first grown on blood serum by Koch, but will not grow without addition of glycerin to the ordinary media. Requires temperature of 37°C . Dry wrinkled growth somewhat like a lichen, on glycerin agar in three weeks. Cultures, especially in glycerinated broth, have fruity odour.

* Distinguish Fuchsin from **Acid Fuchsin**, *Syn.* Fuchsin 'S,' **Acid Magenta**. A mixture of the Ammonium and Sodium Salts of trisulphonic acids of Rosaniline and para-Rosaniline. It is made by sulphonating Rosaniline Monohydrochloride (Fuchsin) with 'Oleum' and neutralising the sulphonic acids obtained. It is more soluble than ordinary Magenta. The formula of Sodium Acid Fuchsin is $\text{C}_{30}\text{H}_{16}\text{N}_3(\text{SO}_3\text{Na})_3\cdot\text{H}_2\text{O}$.

To obtain a pure culture of the organism from tubercular material it is necessary to inoculate guinea-pigs with same and after a lapse of four to six weeks cultures are made from enlarged glands direct on to blood serum or glycerin potato. Glycerin agar is not recommended for use direct *post mortem*, but the organism flourishes on this on sub-culture.

Change in the morphology and staining powers by growth on Sperm Oil and Glycerin-egg medium.—A. H. Miller, L. ii./14,739; i./15,704.

To exclude Acid-fast Bacilli and all other Bacteria except Tubercle and Leprosy.

1. Wash film in Alcohol after fixing by radiant heat
2. Stain with hot Carbol Fuchsin.
3. Differentiate in 25% Sulphuric Acid and wash freely in tap water and Alcohol.
4. Counterstain in Picric Acid and Alcoholic Solution. Dry and examine by 1/12th inch immersion lens.—Wyatt Wingrave.

POINTS OF DIFFERENCE BETWEEN HUMAN & BOVINE TUBERCLE BACILLI

Human.	Bovine.
<i>Longer and slender.</i>	<i>Shorter, thicker, stumpy.</i>
<i>Fasciculated.</i>	<i>Discrete, not in bundles.</i>
<i>Colour true.</i>	<i>Not colour true, receptive of blue.</i>
<i>Beading well marked and regular</i>	<i>Beading less marked.</i>

—Wyatt Wingrave.

The “**Picric**” Method (for the staining of both types of bacilli) Picric Acid is used as a mordant for the Fuchsin, in addition to the Phenol. Twin films are used for comparison, one being taken for the “Ziehl-Neelsen” method, and the other for the “Picric.” Stain with Carbol-Fuchsin with gentle heating. Pour off Fuchsin, and add Alcoholic Solution of Picric Acid until film is yellow, wash and dry.

Hermann’s Crystal Violet Method and Much’s Modified Gram Method of staining *B. Tuberculosis* are described in the B.M.J. ii./12,412. The former has some disadvantage in technique. Much’s method is not suitable for direct investigation of sputum. (See also B.M.J.E. ii./09,44).

The Royal Commission on Tuberculosis found it impossible to differentiate between the human and bovine types of tubercle bacilli by means of staining methods.

ANTIFORMIN (Patented in 1900) contains about 7.5% free Sodium Hydrate and 5.3% available Chlorine. Another statement is to the effect that its composition is equal parts of Liquor Sodæ Chlorinatæ and 15% Solution of Sodium Hydrate. A disinfectant. In 2 to 5% dilution kills most bacteria in 5 minutes. Anthrax Spores, require 10% for 12 hours. It does not, however, kill Tubercle bacilli (probably by reason of the fatty envelope which is believed to enclose them). It can be used to isolate the bacillus from the sputum—particles can be removed by macerating 2 hours 20 to 30 Cc. of tuberculous sputum with 15 Cc. of the Antiformin and diluting with water to 100 Cc. These inseminated on blood serum are stated to produce a pure culture—or may be used for staining direct, *vide infra*.

‘The Lancet’ found 4.12% available chlorine and 7.6% Sodium Hydrate.—L. i./15,918.

A preparation similar can be made by passing Chlorine into 15% Sodium Hydroxide Solution to near saturation.—L. i./15,356.

The following is also stated to be an efficient substitute :—

Mix Chlorinated Lime 80 Gm. with water 400 Cc. Dissolve separately Potassium Carbonate 58 Gm. in boiling water 300 Cc., and pour the hot solution into the former. Shake, set aside to cool, and make up to 1000 Cc. Mix this with an equal volume of 15% Sodium Hydrate solution.—Pres.

It dissolves hair, wool, silk, etc., also 0.5% is stated to dissolve Cholera Vibrios, Spirochetes, Trypanosomes in 5 minutes, while a 2.5 to 5% solution completely destroys vegetative forms of bacteria.

Antiformin Method of isolating *B. Tuberculosis*—(modified by Koslow). Shake the Sputum with Antiformin in a glass stoppered cylinder, the amount of Antiformin varying with the consistence of the sputum,—if very viscid or dense, an equal volume, if thin, half the amount may suffice, occasionally during five minutes, then dilute with Distilled water approximately 10 times the amount of Antiformin used,—again shake a few minutes. Finally add a mixture of equal parts of Ether and Acetone, equal in volume to that of the water. Shake a few seconds and allow to stand. Three layers

will form. The middle one,—a more or less white ring, will contain nearly all the Tubercle Bacillus present in the sputum. Draw off with aid of a pipette and test. This may be centrifugalised but it is not necessary. Before staining it is well to wash film in 5% Sulphuric Acid to neutralise adhering alkali, then wash to remove acid.

Loeffler's Modified Antiformin Method.—To 5 to 20 Cc. of sputum add equal volume of Antiformin 50% diluted with water. Heat until clear liquid results. To 10 Cc. of the mixture add 10% Solution of Chloroform in Alcohol (5 Cc. generally suffices). After shaking centrifugalise 15 minutes. An opaque layer is then formed between the Chloroform which occupies the bottom of the centrifuge and the supernatant fluid. Pipette off the latter and remove the opaque layer wholly on to a slide. Make films fix and stain. This method is said to be rapid and simple and to give good results.—L. ii./11,1747.

As used at the Lister Institute the sputum is mixed with an equal quantity of a 30% dilution of Antiformin, and the mixture incubated over-night at 37° C. After centrifugalising the fluid is poured off and replaced by an equal bulk of Normal Saline. After shaking up, again centrifugalise. Films from the deposit thus washed adhere better to the slide. Its use is justified by small percentage of 'corrections.'—B.M.J. ii./12,411.

Cruikshank employs Antiformin for isolation of the bacillus, then inoculating Glycerinated Egg Medium with centrifugalised sediment. The Bovine Bacillus grows best *without* Glycerin.—B.M.J. ii./12,1298. Emery, Pr. Feb. 1910, p. 467.

Detection of Tuberculosis in fæces by aid of Antiformin. Until recently it was thought that the discovery of *B. tuberculosis* in fæces was diagnostic of tuberculous enteritis,—the bacillus, however, frequently occurs in fæces of patients suffering from pulmonary tuberculosis.

Acid-fast bacteria resist Antiformin when diluted to 20% for 2 to 5 hours—other bacteria and organic matter generally are speedily dissolved. A small piece of fæces (about a cubic $\frac{1}{2}$ inch in size) is placed in a conical glass and to this some 20 Cc. of Antiformin diluted with Water to 15% is added and the whole well mixed. More of the diluted Antiformin is added and the mixture allowed to stand for about an hour. A white curdy precipitate appears on mixing and settles. Beneath this white layer some unchanged fæcal matter remains and above the white layer the fluid is of a clear yellow or brownish color. A drop or two from the white curdy layer is mixed with a drop of Albumin Water and stained by the Ziehl Neelsen method. Much searching may be necessary. For certainty Alcohol may be used in addition to Acid for decolorising.—B.M.J. ii./10, 84; L. ii./10,1747. See also B.M.J.E. i./10,36

Albumin Reaction in Tuberculosis.

The reaction is conducted as follows:—5 Cc. of Sputum are mixed with 20 Cc. of Normal Saline in a test tube. 5 or 6 drops of Acetic Acid are added and the whole shaken up and filtered. The filtrate is then tested for albumin by heat or nitric acid, using the boiling test in preference. It is said to be more useful than microscopic examination for diagnosis of tuberculous disease of the lung, even in early stages when it may be difficult or impossible to find the bacilli in the sputum. A reaction for Albumin is not constantly given in miliary tuberculosis nor in pleurisy. It is present in acute lobar pneumonia due to pneumococci during the attack, also in acute pulmonary œdema, acute congestion and acute broncho-pneumonia. As a rule it is negative in chronic bronchitis and in emphysema. In cardio-renal cases it is often positive. The intensity of the reaction in phthisis is in direct proportion to the importance and gravity of the lesions and abundance of tubercle bacilli.—L. ii./11,1084 (Clinical results with the test), 1660 (no great diagnostic value).—L. ii./11,1802.

It is a good plan to shake up the sputum with about three volumes of water, filter, centrifugalise the filtrate and stain the sediment carefully picked up with a fine pipette. Bacilli slip through the filter paper leaving cells and debris behind, and are then more easily found. Further conduct the *Albumin Test* on the filtrate, first removing Mucin with a few drops of Glacial Acetic Acid and adding a little salt solution and again filtering. W. E. Home states he has not found Tubercle Bacilli in a non-albuminous urine.—L. i./13,1828.

Practically all cases of active pulmonary tuberculosis, it is said, contain albumin in the sputum. Significance and causation 98.9% of specimens containing Tubercle Bacilli also contain Albumin.—L. ii./13,382,578.

Of prognostic value, but not conclusive.—Fishberg, quoted by W. D'Este Emery, Pr. Feb. 1913.

Urine—At least six films should be prepared. The specimen is centrifuged, the supernatant liquor is poured off, and the sediment is washed two or three times by shaking up with sterile water, centrifuging on each occasion, fix film with alcohol. Stain as for sputum, by Picric Acid method. Smegma B. is acid- but not acid- and alcohol-fast. Always wash film with albumen water before staining.

Russ has endeavoured to detect tubercle bacilli in urine, milk, &c., by aid of an **electrical current**. The movement of the organisms in an emulsion toward one of the poles is possibly due to chemical affinity, or to their being driven mechanically by the ions. To detect the bacilli in pathological fluid by means of a current it is necessary to add to the fluid an electrolyte in which the organisms are known to migrate. Of a number of substances tried Ethylamine was found to be best for the purpose. This produced a fair accumulation of bacilli at the kathode. The aggregation is probably due to an affinity between the products of electrolysis and the bacteria. The method has great detective capacity. Various bacteria behave differently, suggesting the possible use of the method for diagnosis.—L. ii./09,2; B.M.J. ii./09,81.

The routine examination of urine of all patients suffering from albuminuria irrespective of whether blood or pus is present, will reveal presence of tubercle in a surprisingly large number of totally unsuspected cases.

Ligroin method of Detection:—To 5 Cc. of Sputum in a flask add 50 Cc. Caustic Potash Solution 5%. Shake and leave at room temperature until the sputum is homogenised. Dilute with 50 Cc. tap water and shake again. Add 2 Cc. Ligroin and shake until emulsion is formed. Warm to 60° C. until evidence of layer of smaller bubbles on the surface. A number of drops are then taken from immediately below this superficial layer and placed on a warm slide. The dry film is then fixed with Saturated Sublimate Solution and stained by Ziehl-Neelsen method—L. ii./10,1747. The Ligroin causes the Tubercle Bacilli to rise to the surface of the meeting of the two liquids.

Ericolin Separation of B. Tuberculosis.—The difficulty of contamination with other organisms, encountered when making cultures of the Tubercle Bacillus directly from a patient's sputum has been overcome by Twort, who uses the glucoside 'Ericolin' in a 2% aqueous solution. This it is said, gets rid of the other organisms. He places the piece of sputum in the Solution for about an hour at 38° C., inoculates suitable media and so obtains a growth almost, or quite free from contamination in 14 to 28 days.—Brit. Jl. of Tuberculosis, Vol. IV. (April, 1910), p. 113.

(Ericolin is stated to be a constituent of *Erica Vulgaris*. Linn. Syn. *Calluna Vulgaris*, **Heather**, with formula $C_{34}H_{56}O_{21}(?)$.)

In some experiments by us to produce a glucoside from the plant, both Aqueous and Alcoholic Extractives were made and precipitated with Neutral Lead Acetate. The Liquor was freed in each case from Lead by Sodium Sulphate and then evaporated. The Aqueous Method yielded a small quantity of brownish extractive. The Alcoholic Method was carried further as follows. Concentrated to small bulk and precipitated with water—greenish resinoid 'Ericolin' obtained in appreciable quantity.

Heather suggested as a substitute for tea by the Germans. Little is known of the effects of Ericolin on the human organism.—P.J. i./15,41.

Blood.—The organism it is stated can be demonstrated in the blood of tuberculous patients by shaking, say 5 Cc. removed from a vein, with an equal quantity of Normal Saline with 2% Sodium Citrate. Place in refrigerator 24 hours. Remove sediment with pipette and dry on slide with moderate heat. Place slide in distilled water until the blood is completely laked. Fix films and stain. Work at Brompton, however, did not confirm.

The blood of 22 cases of pulmonary tuberculosis examined in all stages and two acid-fast bacilli seen—considered accidental.—B.M.J. ii./09,1119; L. ii./10,1747.

Milk.—In spite of supervision it is no doubt true that a very large proportion of samples of milk supplied currently for human consumption are tuberculous; see also p. 537-538. The staining for *B. tuberculosis* is similar

to that used for urine. Both the cream and the sediment must be carefully searched on centrifugalising. It is well to soak the slides at the outset after drying and fixing, in ether for a minute or two to remove the fat. Stain by Picric Acid method to exclude butter bacilli. *Negative results in all instances are not necessarily conclusive of absence of infection.* Injection of susceptible animals is then necessary for confirmation.

Acid-Fast Bacteria. In addition to *B. tuberculosis*, *B. Leprae* (*q.v.*) and the *Smegma Bacillus* which resists acid by the Zeihl-Neelsen method the following organisms give identically similar reaction.

1. *Timothy Grass Bacillus*. Syn. *Moeller's Grass Bacillus* producing lesions closely resembling tubercles. Another variety of this organism has been found in the dust of hay lofts, and a third variety is known as the 'Mist bacillus' (*Dung bacillus*).

2. The *Petri-Rabinowitch Butter Bacillus* producing lesions closely allied to tuberculosis when injected into the peritoneal cavity of guinea-pigs.

Only in the case of material where outside contamination has been possible do these Bacilli '1' and '2' become an element for consideration—*i.e.*, the customary method of examination is practically of unvarying value.—Muir and Ritchie.

Acid-fast bacilli are common in chronic ear discharges and **atrophic rhinitis**.—(Wyatt Wingrave, Roy. Soc. Med. Otol. Sec., 1908). Acid-fast organisms (but not alcohol-fast) present in every case of true atrophic rhinitis (*ozæna*) but in no other disease of the nose. Further work shows that a certain acid- and alcohol-fast bacillus possessing close morphological and tinctorial resemblance to *T. B.* producing lesions undistinguishable from tuberculosis is present in every such case. To exclude tubercle other films in addition to the Z-N films are heat stained by carbol-fuchsin, then passed through the acid bath and washed freely in alcohol before counterstaining—preferably in saturated alcoholic picric acid. This proves them to be alcohol- as well as acid-fast; some of the special bacilli in question are only acid-fast. Some are, however, distinctly alcohol-fast. The Zeihl-Neelsen stain is only roughly diagnostic and not so precise as picro-fuchsin which emphatically excludes all bacilli which are only acid-fast.—Wyatt Wingrave, *Jl. Laryngology* Vol. xxxi., No. 7, July, '16.

The only way for the Local Govt. Board—not local authorities—to effect a complete change in present conditions of supply of milk would be to appoint competent Veterinary Surgeons to examine all dairy farms and to insist that all tuberculous cows be slaughtered, recompensing the farmer—this to come out of National funds, not out of local rates.—Williams, *London Pure Milk Association*.

The London County Council as far back as 1907 obtained powers to inspect cows in every county to prevent the sending of tuberculous milk to London. The cost has been £4,000 a year. In the first 2½ years 34,000 cows were examined, 534 cases of tubercular disease were discovered and the milk from these animals was kept out of London. Legislation wanted to prohibit the sale of tuberculous milk and to punish offenders.—From the *Daily Press*, July 12, 1911.

The proportion of tuberculous cows is placed by some authorities at 1/6 of the entire bovine population.

Milk and Dairies Bill for Scotland, see *P. J. Supp.* i./09, 391; *B.M.J.* i./09, 1451.

Infection of children with Bovine Tubercle Bacilli. Unsterilised milk in this country is the vehicle by which tubercle bacilli must most frequently be introduced into the bodies of children. **Cow's Milk** containing bovine tubercle bacilli is the cause of 90% of the cases of tuberculous cervical glands in infants and children residing in Edinburgh and district—in which the research was conducted—and is responsible for by far the larger proportion of tuberculous cervical glands in children during the milk drinking period of life (0 to 5 years). Strong arguments are put forward for protection by legislative measures.—A. Philip Mitchell, *B.M.J.* i./14, 125.

Bread and the spread of tuberculosis. Experiments by mixing tuberculous sputum with the dough. Though the results were negative after baking—in the case of large loaves the temperature in the centre might be insufficient to kill the bacilli.—*L.* i./13, 987.

Prevalence of pulmonary tuberculosis increases considerably in districts exposed to strong **Rainbearing Winds**, *e.g.*, in those exposed to W., S W.

and N.W. winds. In these districts in England death rate is 1 per 1,000 *per annum*, and in districts sheltered from these winds the rate is nil. Pr., Jan., '13,300.

Pathogenicity of *B. tuberculosis* stored in normal saline markedly decreased.—L. S. Dudgeon, L. ii./14,210.

Opsonins have been regarded as non-dialysable proteid substances contained in the serum or plasma of the blood—they are probably formed in the muscle tissue. They possess the power of influencing bacteria in such a way as to render them more easily attacked by phagocytes.

In addition there are said to be bodies variously named agglutinins, precipitins, lysins, and stimulins. To the last named Metchnikoff in particular attributes the power of stimulating the phagocytes to destroy invading organisms. This worker assigns to 'Opsonins' a secondary role.

The demonstration of the presence of some such body or bodies by cultivation of (a) Bacterial Emulsion and washed corpuscles compared with (b) Bacterial Emulsion and corpuscles *previously acted upon by Blood Serum* is a comparatively simple and conclusive experiment proving its or their presence.

With regard to the part played by Opsonins in defence some claim that they are allied to the complement of Ehrlich. As now viewed, these bodies do not hold the important place formerly attributed to them by Wright and his school—it is more probable that defensive mechanism against bacteria depends rather upon some unknown enzyme comparable to that elaborated by the organism when any foreign element is introduced into the tissues.

The action of Opsonins is, to a certain extent, independent of quantity, and they are decomposed by heating Serum at 60° C.: on the other hand in the dried condition they will withstand 120° C. Experiments show that there exists a **Preopsonin** which, when necessity arises yields the appropriate Opsonin for a given bacterium.

It is obviously necessary at the outset to determine the nature of the disease to be treated by the examination of the blood or pus.

The Opsonic Index for a given organism, *e.g.*, *B. tuberculosis*, is the ratio of the opsonic power of the serum of a patient compared with that of the normal being.

The Index as a means of diagnosis is not now employed to any extent.

In our last edition, page 349, we gave details for collecting blood for determination of the Index and the conclusions to be drawn.

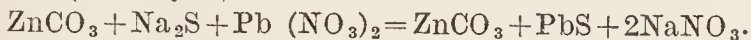
Serum Diagnosis of Tuberculosis.

Application of the Bordet-Gengou Reaction.—Determination of Specific Amboceptor in the patient's serum in treatment with Tuberculins.

One can, according to Wassermann and Bruck, determine, by means of the complement deviation, the presence of minute quantities of bacterial matter on the one hand and of corresponding antibodies on the other. Tuberculin is mixed with the serum of patients in graduated quantities and a small quantity of fresh normal guinea-pig serum, *i.e.*, complement-containing, is added to each of these mixtures. After an hour at 37° C. a specific hæmolytic serum, previously inactivated by heat is added to each mixture, and then some red blood corpuscles towards which the serum possesses hæmolytic properties. The hæmolytic power of the serum must naturally have been previously determined. If there are any specific amboceptors present in the serum to be examined, they will combine on the one hand with the Tuberculin, on the other with complement of the normal guinea-pig serum, hence there will be no hæmolysis as the hæmolysing power of the specific hæmolytic serum necessitates the co-operation of the free complement.

In this way the presence of Antituberculins in the blood of tuberculous patients, at least in such cases as had been treated with specific Tuberculin preparations, can be shown and the determination of the amount of anti-tuberculin in the patient's sera gives an index of the degree of immunisation, but the amount of specific immunising bodies will doubtless vary independently in the same way as do the Opsonins. Further, in isolated cases, an observed positive complement fixation has possibly not been caused by the fixation of a specific amboceptor, but through free Tuberculin, as Tuberculin as such, at least in large doses, is in itself complement fixing. Control tests are, therefore, essential.

The reaction amounts to a modified Wasserman Test. Chemists will appreciate the following method of viewing the reaction,—“ Let the Bacterium or organism be represented by Zinc Carbonate,—the complement by Sodium Sulphide Na_2S , the immune body by H_2SO_4 , Sheep's corpuscles by Lead Nitrate $\text{Pb}(\text{NO}_3)_2$. Then ZnCO_3 and H_2SO_4 form a compound which combines with Na_2S forming ZnS and Na_2SO_4 . ZnCO_3 cannot combine without intervention of H_2SO_4 . Now if to this mixture of bacterium (ZnCO_3), immune body H_2SO_4 and complement (Na_2S) some Lead Nitrate (Sheep's corpuscles) be added no Black Lead Sulphide will be formed (no hæmolysis). But if the immune body be excluded from the mixture a black precipitate will result (hæmolysis).



It will be seen that one molecule of the immune body H_2SO_4 absorbs 1 molecule of complement Na_2S in the presence of its specific bacterium (ZnCO_3), and if there is more complement present than immune body some complement (Soluble Sulphide) will remain unabsorbed and will produce blackening with Lead Nitrate, and thus the trace of immune body is likely to be overlooked. In tubercle there are frequently only very small traces of immune body—usually $\frac{1}{2}$ part of the complement present.—V. B. Nesfield, L. ii./10, 1875. For application to syphilis v.p. 515 *et seq.*

The directions in question should be read in conjunction with the criticism of D'Este Emery to the effect that Emulsion of killed Tubercle Bacilli was found better than Tuberculin as Antigen,—the Emulsion to be accurately standardised—*e.g.*, to 4% bacillary substance. The criterion as to the strength of the reaction is the time necessary for the complete absorption of all complement when the Serum and Emulsion are mixed in certain proportions (1:4) and incubated—using sensitised human corpuscles. In health the absorption time is 15 to 25 minutes—in 40 tuberculous cases under $2\frac{1}{2}$ minutes. Prognosis is good when the serum contains a large amount of antibody and therefore has a **short absorption time**. Emery has seen patients improve on a shortening time and *vice versa*,—but this is not invariable. The method has advantage over the eye-destroying counting Opsonic Method.—L. i./11,56. Further notes by V. B. Nesfield.—L. i./11,126.

D'Este Emery in reply says practically all persons,—adults especially—have in their blood antibodies to the tubercle bacillus, therefore any diagnostic method must be quantitative, *e.g.*, the estimation of the time in which Complement absorption takes place with an Emulsion of Bacteria of definite strength under standard conditions. All **hæmolytic observations** on Hecht's method are liable to be vitiated by the fact that the *amount of amboceptor is subject to variations* as yet unmeasured,—this with the variation in the amount of the complement renders accurate work difficult.—L. i./11,190.

There are two opposite factors in the process of cure of an infective disease,—on the one hand an increase in the defensive forces tending to cause immunity, and on the other, a specific raising of the sensitiveness of the body to the microbe or its toxin so that it tends to become *less* immune. The latter process is called ANAPHYLAXIS (opposed to prophylaxis). In the case of tuberculosis the first effect of a tuberculous lesion is to raise the susceptibility of all parts of the body to the tuberculous toxin. This substance,—Tuberculin, is practically without action on a normal person. It is only when he is *sensitised* by a previous dose or doses that it becomes a real toxin. This process is in the highest degree disadvantageous to the patient,—the tuberculous fever when not due to secondary infection is apparently an entirely anaphylactic reaction to doses of Tuberculin too small to have any action on a healthy person. It appears, however, that this stage is essential to the production of immunity. Both anaphylaxis and immunity are specific—either may serve in diagnosis. The great *majority of adults have already acquired some immunity to tuberculosis*. Children very commonly have a small tuberculous focus (94% in Vienna amongst the poor become tuberculous before reaching the age of 14) causing no apparent symptoms. Everybody is being constantly vaccinated against the Tubercle Bacillus *via* the alimentary canal and lungs. The traditional peck of dirt must contain innumerable millions of tubercle bacilli. The immunisation or preventive treatment so caused is absent to a great extent in childhood. Adults as a class show sign of having been rendered partially immune to the tubercle bacillus and this renders the

diagnosis by the immunity reaction more difficult than in children.—Von Pirquet's test is entirely satisfactory in childhood but of less value in adults.—W. D'Este Emery.—L. i./11, 485.

THIS ANAPHYLAXIS or INCREASED SUSCEPTIBILITY—the most familiar instance of which is the Serum 'disease' which sometimes occurs after injection of Diphtheria Antitoxin, according to this is an essential feature in bodily response to infection and invasion of the tissue fluids by alien Proteins or Antigens. It forms the basis of the Tuberculin Reaction, since it is only after sensitisation to these substances by previous injection, or by a pre-existent lesion, that the specific reactions occur. Hyper-susceptibility is as much specific as the more obvious or protective immunity. Emery reviewed the various diagnostic methods for tubercle depending on the presence of the various antibodies and pointed out the difficulties with all. A single determination of the Opsonic Index for example is now generally admitted to be only of value if it fall considerably outside the somewhat wide limits allowed (0.8 to 1.2). The Bordet-Gengou Reaction (*q.v.*) is applicable if made quantitative. He modified it by determining the absorption time of complement by Serums in presence of the Antigen which is a standard Bacillary Emulsion, using Blood Corpuscles as indicator—absence of hæmolysis is the index of absorption of complement. In 34 cases of diseases other than tuberculosis and of healthy persons, the average absorption time was 18.1 minutes,—the maximum being 35 and the minimum 2.5. In tuberculosis the average was 7.4 minutes. Absorption times of less than 2.5 minutes were obtained in 25 out of 56 Tuberculous Serums examined. If this time be taken as the criterion the test was therefore obtained in 44.6% of tuberculous and in 8.8% of non-tuberculous.—L. i./11, 564, 594.

A. C. Inman on Complement Fixation Test.—L. i./14, 1446.

Precipitation method for estimation of approximate immunity against tuberculosis.—W. H. Fearis, *Pr. Apl.* 1913, 713.

Complement Fixation Test in tuberculosis.—E. Filder, L. ii./18, 844. See also Chung Yik Wang and J. Crocket, *B.M.J.* ii./19, 17.

Specific means of diagnosis. Negative reactions as reliable as positive.—A. L. Punch, L. ii./20 647.

Spahlinger's Serum. See L. i./21, 397, 448. Secrecy prevents trials here—Dr. Addison, L. i./21, 563.

Typhoid Fever—*Bacillus Typhosus*.

Widal's Reaction.—Collect sample of blood in a small capillary pipette, and seal the ends, that nearest the blood being closed first. By pricking the lobe of the ear or the finger the blood will run into the tube by capillarity. The serum is allowed to separate, or the tube is centrifugalised to cause as complete a separation as possible of corpuscles which may mask a reaction. The serum is blown out on to the corner of a slide and a platinum loopful is mixed with 9 loopfuls of normal saline solution, and one loopful of this 1 in 10 dilution is mixed with two loopfuls of typhoid broth, not more than 24 hours old, preferably filtered through ordinary filter paper. This 1 in 30 dilution is now examined as a hanging drop. A control experiment must be conducted in addition.

Positive Reaction.—Complete: Clumping of organisms and cessation of movement as a rule in under 30 minutes, or may be instantaneous. Partial reaction: Sluggish movement providing the control is actively motile. Negative reaction: No alteration in 1 hour. Dilutions 1 in 100 should give same results in 50 minutes; if the time exceeds this the diagnosis is doubtful.

The reaction may also be performed in similar dilutions in sealed capillary pipettes (Wright). This constitutes the macroscopic method of applying Widal's Reaction.

The urine and other excretions of typhoid patients also possess agglutinative power. It is stated that if the serum be heated to 80° C. for one hour its agglutinative power is lost.

Notes of Caution in Applying.—The broth itself or a control with normal serum should first be examined to see that the organisms are freely motile and show no pseudo clumps, as clumps are sometimes present in the broth before the addition of the blood. The serum of persons having previously had typhoid may react even years after. This may cause confusion where a typhoid diagnosis had not been given. Again, if only slightly diluted,

e.g., 1 in 10, normal serum frequently 'clumps,' which is not the case on further dilution,—1 in 30 or 50 is safest. Some workers require a result with a 1 in 200 dilution within half an hour to be positive. Too great a dilution may obscure. The blood of *all* cases does not react, case may be too early (generally obtained about end of first week). Cases are recorded where reaction intermits, absent one day, present next, and again recurs, and also a few described where there was no reaction throughout the disease, but these are fortunately very rare.

A special culture should always be at hand—one known to react, as occasionally laboratory cultures do not respond.

Blood letting in patients was speedily followed by a rise in the specific agglutinating power of their serum.—B.M.J. i./10,104.

The variability of agglutination of *B. Typhosus* and *M. Melitensis* by normal sera.—L. ii./11,877.

Anomaly in the Reaction.—In examining blood of patients suspected of enteric group infections using Dreyer's Standard Method, 'Zone phenomena' were frequently seen, *i.e.* the occurrence of agglutination in higher dilutions of a serum while lower ranges failed to agglutinate. It is more striking by the macroscopic (Dreyer) method than the microscopic. It was found that the addition of another serum, non-agglutinating to the bacillus under test increases the zone of inhibition. The presence of salt in the test augments but does not cause the negative zone.—A. F. S. Sladden, L.ii./16,272.

Standard cultures and agglutinating sera for diagnosis by macroscopic agglutination tests are prepared at the Department of Pathology, Oxford, including *B. typhosus*, *B. paratyphosus* 'A' and *B. paratyphosus* 'B,' *B. dysenteriae* (Shiga, Flexner & Y.), *B. enteritidis* (Gärtner).—B.M.J. ii./16,595.

Rapid Method of Conducting Widal's Reaction.

Spread a film of the blood on one half of each of two slides—the slides being divided by a coloured glass writing pencil. On the other half of each spread films of blood of a normal (one who has not been prophylactically inoculated or had typhoid) as control. Dry. Place a small drop of an Emulsion of *B. Typhosus* in normal Saline killed with 1 per cent. Formalin on the centre of each half of both slides. Rub well in, care being taken not to mix the halves.

On *one* slide place a cover glass on each half, taking care that the two cover glasses are well separated in the middle by the pencil mark. Place the *other* slide on a piece of wet blotting paper and cover with a Petri dish for 15 to 20 minutes. Then dry carefully and stain with Leishman's or Giemsa's stain.

At the end of 15 minutes or earlier, 'clumps' will be seen in the first slide with a low power if typhoid, without 'clumping' in the control.

The test may also be conducted against Paratyphoid 'A' and 'B.' The other film can be used to determine the presence or absence of leucocytosis.—A. C. Coles, B.M.J. i./16,684.

Bordet-Gengou Reaction. This test is claimed to be specific for typhoid. "To conduct the test a susceptible animal is injected with a culture of the typhoid bacillus. This develops amongst other bodies a bacteriolysin, *i.e.*, the complement, naturally occurring combines with an amboceptor, produced by the liberation from certain cells of the inoculated animal of receptors having 2 affinities, one for the complement and one for the bacilli. The inoculated animal is bled and its serum is obtained after whipping the blood by centrifugalization. The serum is then heated for $\frac{1}{2}$ hour at 57° C. that is 'inactivated' or deprived of complement. The complement being destroyed, free amboceptors are present in the serum, a measured quantity of which is mixed with some of the original antigen used—*i.e.* an emulsion of typhoid bacilli and a measured quantity of the serum of a normal guinea-pig is added. The three constituents are heated about 1 hour at 37° C. By this procedure the amboceptor is enabled to link itself by its cytophile affinity to the bacteria and by its complementophile affinity with the complement contained in such abundance in the serum of a normal guinea-pig. The complement is thus 'anchored' to the amboceptor and is no longer free to combine with any other amboceptor. To this complement another amboceptor is offered, and the inability of the complement to become anchored to another is taken as an indication of the affinity of the first-named amboceptor for *B. Typhosus*.

"If the inactive serum of a normal animal not immunised against *B. Typhosus* be placed in contact with these bacilli and guinea-pig complement, no anchoring of the latter body will take place, and it will be free to enter into any other alliance of suitable character available.

If a rabbit be immunised by injecting it, say, with washed red sheep's corpuscles—a hæmolytic serum is produced, *i.e.*, in the rabbit's serum an amboceptor is developed, which by combining with rabbit's complement on the one hand and sheep's corpuscles on the other, produces such an effect that the latter are laked, the hæmoglobin being transfused into the normal saline solution, with which a suspension of the sheep's corpuscles is made. Before exposing the rabbit's serum to the suspension of sheep's corpuscles it is heated to 57° C. In this way the rabbit's complement is destroyed and hæmolytic amboceptors left free, which though capable of combining with sheep's corpuscles, do not in such combination lake the latter because no complement is available. For application of the Reaction to Tuberculosis, p. 544.

Wassermann's Reaction (*q.v.*) is analogous with this test.

In diagnosis the agglutination reaction has been chiefly used on account of its comparative simplicity, but the fixation or deviation of complement can be and has been used in a great many different diseases to demonstrate the existence of specific anti-substances in the blood and so serve as diagnostic. Thus, *e.g.*, if a small amount of serum (heated to 55° C. to destroy the complement) from a typhoid patient added to a quantity of Emulsion of *B. Typhosus* the mixture will show the property of absorbing a certain amount of complement, whereas in a control with Normal Serum or with serum from another disease this absorption will not occur.—Prof. Muir, *c.f.*, pp. 519, 520.

Recognition of small quantities of *B. Typhosus* by complement fixation—in the mixed growth obtained on plates inoculated with an emulsion of fæces.—B.M.J. ii./10, 1516.

RECOGNITION OF *B. TYPHOSUS*.—Gram —. Length 2 to 4 μ . Long and coccil forms in cultures. Actively motile flagella well seen by dark ground illumination; they may be stained by McCrorie's, Van Ermengem's, or Pitfield's methods, are long and wavy, 12 to 16 in number, though films usually do not show more than 8 to 10, a large number of detached flagella being also visible. No indol production.

The flagella actively motile can be shown by Pollard's Method (*vide infra*).

A permanent slight acid production in litmus milk distinguishes from Gärtner's *Bacillus* which produces marked alkalinity in all cultures (milk is not coagulated by either). Neither this, Gärtner's *Bacillus* nor *B. Coli*, liquefy gelatin.

Growth on potato translucent (that of *B. Coli* and Gärtner's *Bacillus* is brown and moist); in glucose-gelatin no gas formation (differences from *B. Coli*, of which many species are known to exist, and Gärtner's *Bacillus*). The Indol test is not always specific with strains of true *B. Coli*.

Caffeine enrichment method for separating *B. Typhosus* from *B. Coli*, *vide* Bact. Water Examination. *B. Typhosus* is said not to grow in a medium containing 0.01% Arsenious Acid, whereas *B. Coli* will grow in a medium containing 1.5% of same.

Atropine Injection as a means of Diagnosis of the Typhoid group in affections. Atropine 1/33 grain hypodermically hardly increases the pulse rate in Typhoid and Paratyphoid 'A' and 'B' infections, whilst in normal people and those suffering from other diseases it is accelerated. At least one hour should elapse after a meal. Give the injection and allow 25 minutes to elapse—patient remaining absolutely quiet before making second observation. As an arbitrary rule an increase of pulse rate by about 20 or more beats a minute after the injection may be accepted as an indication that patient is probably *not* suffering from typhoid or one of the paratyphoid series. If the increase is only 10 beats or less the reaction is suggestive of infection.—H. Fairley Maris, B.M.J. ii./16, 717; ii./17, 492. The details of the method published as a report by the Med. Res. Com. L. ii./17, 503.

Flagella Stains.

MCCRORIE'S STAINS.—Solution A. Night blue 1 in Alcohol, absolute 20, Alum 1 in water 20, Tannic Acid 1 in water 20. Mix and filter at once. Solution B. Aniline Fuchsin. To 100 Cc. of saturated Aniline Water, add 10 Cc.

of absolute alcohol and 1 Gm. of Fuchsin, or Carbol-Fuchsin diluted may be employed.

VAN ERMENGEM'S STAINS.—A. 1% Osmic Acid Solution 100, Tannin 18, Water 45. B. Silver Nitrate Solution 0.25 to 0.5%. C. Gallic Acid 1, Tannin 0.6, Potassium Acetate fused 2, Water 70.

PITFIELD'S METHOD.—Solution A. Tannin 1 Gm. Water 10 Cc. Do not filter. Solution B. Saturated aqueous solution of Alum 10 Cc., saturated Alcoholic Gentian Violet Solution 1 Cc. Filter and keep in a stoppered bottle. Fuchsin will answer the same purpose as Gentian Violet. Equal parts of A and B mixed, heated to nearly boiling and employed to stain 1 to 3 minutes, wash in water, dry and mount.

POLLARD'S METHOD.—Young agar cultures not more than 24 hours old of a motile micro-organism are employed. An emulsion is made in about 8 Cc. of tap (not distilled) water. Six drops of fresh 5% Tannin Solution are added. After $\frac{3}{4}$ hour a turbidity will be noticed. Shake gently and examine 'hanging-drop' with $\frac{1}{12}$ inch objective, this shows the organism with flagella attached especially round the edge of the drop. Numerous active detached flagella are also visible.

These preparations may be dried and stained by (i.) Simple stain, e.g., Carbol fuchsin or methylene blue; (ii.) Ziehl Neelsen's method. Good results can be obtained with cultures even a year old; in the latter case, however, the organisms are generally non-motile.

Differentiation of B. Typhosus from B. Coli and other similar organisms:—

Gärtner's *Bacillus* thought to be a modification of *B. Coli*, and the above differences not always constant, and even the agglutination test between *B. Typhi abdominalis* and *B. Coli* not always reliable. Stab and stroke cultures on agar containing 0.3% glucose, stained with neutral red, distinguish *B. Coli*, discharging it probably because it is a strong reducing agent, producing a saffron tint with fluorescence in 12 to 24 hours, but *B. Typhi abdominalis* is without action on the red tint.—L. i./₀₁, 613; P.J. i./₀₁, 391.

B. Coli communis is a normal and advantageous inhabitant of the intestine, but may become responsible for an attack of inflammation of the bowel or epidemics of food poisoning.

"Crystal Violet" and neutral red, advocated for distinguishing colonies of *B. Coli* (coloured red) from those of *B. Typhi abdominalis* (also *B. Enteritidis* Gärtner and others), coloured blue to purple. Medium contains Sodium taurocholate to inhibit growth of nearly all but intestinal bacteria. Lactose is another essential component of the medium, as *B. Coli* and congeners decompose it with gas formation.—B.M.J. i./₀₂, 1473.

Conradi evolved a method of early diagnosis of typhoid fever. Researches demonstrated necessity of keeping the blood in a fluid condition, so as to avoid the disinfectant action of those substances which become active on coagulation. Bile is employed for this purpose; in addition, the medium contains 10% peptone and 10% glycerin. The blood from lobe of the ear is drawn into a pipette containing a little bile and mixed with two or three Cc. of the Peptone-glycerin-bile medium in the proportion: blood 1, medium 3. Incubate at 37° C. for 10 to 16 hours and make cultures on agar plates according to the

Drigalski-Conradi formula, q.v. p. 423. Diagnosis can be effected by this method in 26 to 32 hours, and it is applicable as soon as the patient exhibits a febrile temperature.—B.M.J. i./₀₆, 339.

Brilliant Green has been found of service in the elimination of *B. Coli* from cultures which have to be searched for *B. Typhosus*.—P.J. i./₁₄, 592.

With regard to persistence of this and other organisms in London water see p. 427.

Persistence of typhoid bacilli in the kidney after apparent recovery from typhoid—and the Widal reaction also given.—B.M.J. ii./₀₇, 75.

The bacillus could be recovered from bottles intentionally infected with it, in course of an investigation on best mode of disinfecting water for military use, even after washing out 12 times with sterile water.—B.M.J. ii./₀₇, 518.

Sunlight (in India) reduced 240,000 typhoid organisms in $\frac{1}{2}$ hour to 1,000, in 1 hour to 5, and in 2 hours to nil.—L. i./₀₉, 742.

VITALITY OF *B. TYPHOSUS*.—There is considerable difference between the vitality of the organism when grown on artificial culture media and the capacity of the same bacillus for survival under natural conditions. The culture bacilli possess much greater vitality than organisms obtained directly from excreta.—B.M.J. ii./₀₉, 482.

B. Paratyphosus. *Paratyphoid* infection is dealt with in Vol. I. The disease is indistinguishable from typhoid, though generally running a milder course. Intestinal ulcers are identical with those of typhoid. Cases of mixed infection are not rare.—L. i./07,284, 1293, 1571.

Distribution of certain bacilli of the food-poisoning group (*B. Suipestifer* and *B. Paratyphoid* ('*B.*')) more limited in England than abroad.—B.M.J. ii./10,1503.

Variation among bacteria. The author describes a bacillus which was isolated from a former typhoid carrier, and which formed acid but no gas in glucose media, and which fermented lactose at 22° C. but not at 37° C. In not developing gas in glucose media, but forming some Mannite it resembles certain Colon Bacilli of the "anaerogenes" class which form connecting links between *B. Coli* and *B. Typhosus* group of micro-organisms.—B.M.J. ii./10,1909.

Paratyphoid and Meat Poisoning.—F. A. Bainbridge, Lecture I, L. i./12,705; Lecture II, L.i./12,771; Lecture III, L.i./12,849.

Cole & Onslow's Tryptic Broth. A broth using Casein (Lait-proto No. 6; for bacteriological purposes), digesting same with fresh Pancreatic Extract and adjusting the reaction by making the Hydrogen-ion concentration about pH = 7.35.

This reaction is very near that of blood serum and also near the optimum for the growth of most pathogenic organisms.

The broth gives luxuriant growth with the colon-typhoid group, also with *B. diphtheriæ* and the *meningococcus*. It is most useful for testing for *Indol* formation owing to its rich content of free tryptophane. When diluted with its own volume of 0.5% Sodium Chloride it is an excellent medium for detection of *acid and gas* formation. It is also good for making Agar media.

Phenolsulphonephthalein is employed in the medium to differentiate *B. typhosus* and *B. paratyphosus* 'A' and 'B' by a method based on the H ion concentration reached in growth of the organisms. For the separation of 'T' from 'A,' formation of gas in glucose and the rapid fermentation of dulcite by 'A' and not by 'T' are relied on.

Phenolsulphonephthalein is useful as indicator. Does not appear to inhibit growth and is more sensitive than litmus. Lemon yellow in acid solution and red or magenta in alkaline. Solution of strength 0.04% is added to the **Glucose Tryptic Broth** and a **Dulcite Medium** in proportion of 4% of the solution.

Following are the critical points of difference:—

Organism.	Solution "G," Glucose Tryptic Broth and Phenolsulph- onephthalein.	Solution "D," Dulcite Tryptic Broth and Phenolsulph- onephthalein.	Glucose fermen- tation tubes.
<i>B. Typhosus.</i>	Yellow.	Red or pink.	Acid.
<i>B. paratyphosus</i> "A."	Yellow.	Yellow.	Acid and Gas.
<i>B. paratyphosus</i> "B."	Red or pink.	Variable.	Acid and Gas.

S. W. Cole & H. Onslow, L. ii./16,9,1011.

Paratyphoid B. Group. Differentiation of *Aertryke B.* from, also subdivision of the *Aertrycke* organisms.—H. Schütze, L. i./20,93.

Paratyphoid 'C' bacillus as a cause of paratyphoid fever.—L. S. Dudgeon and A. L. Urquhart, L. ii. ii./20,15.

Importance of protection against paratyphoid as well as against typhoid. is dealt with fully in Vol. I. Details of procedure for Agglutination Test.—Prof. Dreyer, E. W. A. Walker and A. G. Gibson, L. i./15,324.

Living autogenous Vaccine used.—B.M.J. i./15,584.

Fermentation Reactions of *B. Typhosus*. Investigations gave the following conclusions:—

(1) The fermentation reactions of *B. Typhosus* are identical up to the 4th day. (2) *B. Typhosus* ferments glucose, mannitol, galactose, and sorbitol with the formation of acid within 24 hours. Dulcitol* and arabinose are fermented more slowly, acid being produced usually during the second or third week. Lactose, saccharose, dextrin, inulin, amygdalin, salicin, raffinose, erythritol and adonitol are not fermented. Gas is never produced by *B. Typhosus*. Litmus milk is turned faintly acid generally within 24 hours, and remains thus permanently. (3) The time taken to ferment dulcitol or arabinose varies widely even in the same culture tested repeatedly, and also amongst daughter colonies from a single-plated culture. (4). The time taken by a given strain of *B. Typhosus* to ferment dulcitol or arabinose is very markedly quickened for that strain by a sojourn in media containing dulcitol or arabinose respectively. (5). Within certain limits the increase in (dulcitol) fermenting powers varies with the length of sojourn in dulcitol-containing medium. (6). The increased activity as regards fermentation of dulcitol persists through several generations of agar cultures but eventually tends to die out. It also persists on stored agar cultures for over a month if this culture be sub-cultivated and tested. (7). No other modifications either as regards agglutination, fermentation reactions or cultural characteristics are seen in the agar cultures after passage through dulcitol (or arabinose) containing media other than the increased activity towards the corresponding "sugar." The cultures after passage through dulcitol become "dulcitol active," and after passage through arabinose "arabinose active." The "dulcitol active" cultures do not show any increased activity towards arabinose, nor do the "arabinose active" cultures show any increased activity towards dulcitol. (8). Mere passage through peptone water or through other sugars, *e.g.*, mannitol, lactose or saccharose—does not increase the fermentative activity towards dulcitol or arabinose. (9). It was not found possible to make *B. Typhosus* ferment lactose or saccharose. (10). By means of passage through appropriate sugars it was found possible to develop two modifications of an anærogenic coliform organism each active towards a new sugar not easily affected by the original strain. (11). The fermentation activity of *B. Typhosus*, while one of remarkable constancy in quality, can be increased in quantity and suggests that certain work of classification amongst colon organisms requires reconsideration.—Bradley, P.R.S.M., Dec 1910.

W. J. Penfold dealing with fermentation of Lactose Peptone Water and of Dulcitol Water by *B. Typhosus*, states it does not ferment arabinose. Fermentation of glycerin and papillæ formation on Isodulcitol.—B.M.J. ii./10, 1672

Typhoid Carriers. On a basis of three persons liable to excrete Typhoid Bacilli per 1000 of population London alone would contain more than 14,000 carriers. The total number of known enteric fever cases in London in 1908 was only 1,357. Carriers however numerous have not prevented the conspicuous decline which has taken place in the prevalence of enteric during the last half century—hence the danger of the average carrier would appear negligible,—measures at present employed in the prevention of the disease seem adequate to cope with the 'carrier' also.—L. ii./10, 1631.

Bacteriology of human bile with especial reference to the typhoid carrier problem. Of 100 Cases 23 were sterile, in 51—or a half—*B. Coli* was isolated in pure culture. *B. Coli* is more frequently found when death is due to intra-abdominal disease than when it is due to affection of other parts. It was, for example, isolated in every case except one, in which death was attributed to appendicitis or peritonitis, but was not once found when it was due to cardiac disease. In only four cases were bacilli of the typhoid-paratyphoid group isolated. There are at large individuals never supposed to have had typhoid fever who are in reality chronic typhoid carriers.—Q. Jl. Med. Jan. 1911.

Brilliant Green and Telluric Acid Isolation Method for Typhoid and Paratyphoid Bacilli. Make the usual smear cultures on plates of Endo's or MacConkey's medium. Simultaneously inoculate peptone water containing Brilliant Green. Employ in preference a series of tubes for each specimen, but

*Dulcitol is synonymous with Dulcite and Melampyrite $C_6H_8(OH)_6$, a sugar from *Melampyrum nemorosum* and other *M.* and *Euonymus* species. It occurs in white crystals soluble in water, slightly in alcohol.

when time prevents this use a concentration of 0.5 Cc. of 1 in 10,000 Brilliant Green in 10 Cc. of medium. Incubate both and if typical colonies are not present or scanty in the solid medium make sub-cultures from the Green tubes into the above mentioned solid media. Incubate.

Telluric Acid is also advised 0.4 Cc. of 1 in 1000 solution with varying amounts of Brilliant Green per 10 Cc. of medium. *B. Typhosus* can sometimes be recovered from fæces by this combination better than in Brilliant Green alone.—C. H. Browning & L. H. D. Thornton, B.M.J. ii./15,248. See also Jl. Path. & Bact., XIX., 1914, p. 127, in which Potassium Tellurate is similarly advised.

The method is useful for detecting a number of carriers. **Brilliant Green has a specially inhibitory effect** on the colon bacillus as contrasted with typhoid and paratyphoid bacilli whilst it has a powerfully bactericidal action on practically all other organisms. Telluric acid is included in the media because it was found that certain organisms giving the ordinary reactions of the enteric group but differing from them in fermenting inositol escaped the action of the Brilliant Green alone but were killed off by the addition of Telluric Acid. Browning's work supported.—A. Leitch, B.M.J. ii./16,317.

Endo's Medium—Dissolve Lemco 10, Sodium Chloride 5, Peptone 10, water 1000, in the autoclave at 120° C. for five minutes. Add 30 grammes of washed agar, and autoclave at 120° C. for fifteen minutes. Filter and neutralise to litmus. Add 10 Cc. of a 10% solution of sodium bicarbonate and 10 grains of lactose. Place in steamer for one half-hour. When plates are to be poured, the above stock (1000 Cc.) should be melted and 5 Cc. of alcoholic basic fuchsin solution (basic fuchsin 3 grammes, alcohol 57 Cc.) added, and 25 Cc. of a 10% solution of sodium sulphite. Then steam for fifteen minutes and pour into plates. Allow to cool and store in the dark till ready for use.

By placing a circle of blotting paper in the lids of the Petri dishes before sterilising them, all the water of condensation is absorbed; this aids greatly in making successful cultures.

The use of the medium with agglutination test is expeditious in isolating *B. Coli* and the para-typhoid organisms. *B. Coli* (being acid-forming) are golden-metallic looking. *Streptococci* form crimson dots. Suspicious colonies (grey coloured) are plated on to Hiss Medium.

Hiss Medium—Dissolve Lemco 5, Sodium Chloride 5, in distilled water 1000 in the autoclave at 120° C. for 5 minutes. Add washed Agar 8 Gm. and melt in autoclave at 130° C. for 5 minutes. Add washed Gelatin 80 Gm. Dissolve and cool to 45° C. Clear with white of one egg at 120° C. for 5 minutes, filter and add 1% Dextrose and sterilise in steamer 1 hour. Fill 5 Cc. tubes and sterilise in steamer again. This medium remains solid at 37° C.—F. B. Bowman.—B.M.J. ii./17,250.

Flies as Typhoid Carriers.—Investigations show that if injected into the flies' intestines they can be recovered as long as six days afterwards. The bacilli were found in the flies' fæces during the space of two days. Similar results with Gaertner's B. but the bacilli were not recovered from the fæces.—B.M.J. ii./10,1271.

Flies in relation to typhoid fever, dysentery, etc. Prof. C. J. Martin concludes:—The facts brought forward in the statistical paper do not necessitate recourse to the hypothesis that carriage by flies dominates the situation. The fly hypothesis is the only one offering a satisfactory interpretation of the extraordinary dependence of the epidemic upon the accumulated effect of temperature. It offers further a ready explanation of the spread of infection to neighbouring children who have no direct personal contact with the patient. Peculiarities of the relation in times between fly prevalence and the epidemic in different localities are not inconsistent with the view that fly carriage is essential to epidemicity. No other interpretation so far forthcoming is nearly so satisfactory.—B.M.J. i./13,1; L. i./13,1.

Cattle and horses as typhoid carriers may explain the erratic behaviour of this disease.—L. ii./12,1543.

B. Typhosus is very **susceptible to acidity**. In wine it rapidly disappears while wine added to water will reduce number if present. 20 Gm. of vinegar per litre kills *B. Typhosus* in an hour. Vegetables eaten raw should be treated with water acidulated with 10 Gm. per litre and left in same for about 1½ hours.—L. i./15,511.

B. Enteritidis Sporogenes (Gärtner).—An anaerobic organism staining by Gram's method, spores only on blood serum (?), which it liquefies. Note on, found in the dejecta of the sufferers in the epidemic of diarrhoea at St. Bartholomew's Hospital in 1895. Detection of in water supplies.—P.J. i./02,25

Said to be the cause of infantile diarrhoea. Growth in milk produces characteristic separation of stringy curd and excessive whey. Extremely pathogenic to guinea-pigs from which pure cultures obtainable from the oedema fluid by growing on blood serum under anaerobic condition, *c.f.* Water Examination, p. 423.

A Gram — variety the cause of outbreak of meat poisoning at Limerick which produced 9 deaths. The outbreak indicates danger of private slaughter-houses and lack of supervision; secondly, the necessity of thorough boiling of economically 'left-over' pieces of meat, especially beef, if they have to be 'used up.'—B.M.J. i./09,1171.

B. Aertrycke infection—three cases. Distinction between this organism and *B. paratyphosus* 'B.'—B.M.J. ii./18,310.

Typhus Fever.

Lice are not the only carriers of the infective agent of the disease, as was shown in 1914 by Hort & Ingram, who were able to reproduce in bonnet monkeys a disease which appeared to be a modified form of typhus by the injection of first cultures on human blood agar of a minute cocco-bacillus recovered from fresh typhus urine. The urine of typhus patients is highly infective. During an attack a patient is probably an acute urinary carrier of infection. Disinfect the urine with 1 in 20 carbolic solution and burn all clothing. A full account of knowledge to date of typhus.—E. C. Hort, B.M.J. i./15,673.

Typhus in Palestine in 1913—14, see B.M.J. i./15,887.

Treatment.—Support the heart by Digitalis or Strophanthus, large injections of Camphorated Oil, injections of Rhum, and injections of Adrenalin if syncopal attacks occur. Avoid antipyretic drugs. Optoquin 1 to 2.5 Gm. daily *per os* has been advised by German physicians to be taken so long as patient can swallow. When coma supervenes it has been advised to be given in oil hypodermically. Said to cut short the febrile period and lessen mortality.—B.M.J. i./16,621.

Notes on about 1,800 cases in the Serbia epidemic 1915. Incubation period varies from 5 to 14 days. Usually a period of 12 days—onset of 2 days and a fever of 16 days resolving in lysis. Careful nursing essential. Washing the mouth out with **Permanganate** or in preference **Hydrogen Peroxide** to obviate parotitis, otitis and the like. Alcohol thought to aggravate cerebral symptoms. Ice to the head.—T. Gwynne Maitland, B.M.J. ii./15,283.

Nose breathing valuable precaution in Typhus epidemics. Ordinary Kerosene kills vermin. The entire body may be treated with it or the Kerosene mixed with vaseline.—B.M.J. ii./15,492.

2,000 cases in a German prison camp. Patients did well on the starvation diet. Camphorated Oil by hypodermic and intramuscular injection, but not found good. There was much abscess formation. **Morphine** is a sheet anchor. Expectant and symptomatic treatment best.—P. C. T. Davy and A. J. Brown, B.M.J. ii./15,737.

A person unprotected by a previous attack of typhus exposing himself by remaining for some time by a typhus patient in a close, stuffy, unventilated room runs risk of infection, though there are no lice present. Cubic air space and ventilation essential.—J. W. Allan, B.M.J. ii./15,841.

There is high fatality among the more prosperous classes. B.M.J. i./16 705.

Chadwick's Lectures on Typhus in Serbia—a full description of the fever—a disease which flourishes specially in times of war owing to over-crowding, physical exhaustion and ill-nourishment. Historical notes on outbreaks. Kerosene or equal parts of Kerosene and soft paraffin for thoroughly anointing the body an efficient and economical insecticide. R. O. Moon, L. 1/16, 1069, 1111, 1157.

Antitoxin used. Results encouraging (Nicholle and Blaizot from the Pasteur Inst. Tunis.). In making the antitoxin the passage of the virus through a variety of animals is conducted. Treatment to be started early. Daily hypodermic doses to 10 to 20 Cc.—L. ii/16, 950.

OLDER REFERENCES:—

Animal inoculations (monkeys) succeeded for the first time—previously the disease was regarded as special to man. The transmission was effected by 1 Cc. of the blood from a typhus case injected into a young chimpanzee—typical attack after 24 days. The virus in the blood of this animal was found to be increased in virulence. Injected into a macaque the disease developed in 13 days—blood from this injected into others reduced incubation period further. Other types of *macacus*, also dog and white rat were proved immune. The serum of a macaque convalescent was found to be toxic. Human body lice fed on typhus-monkeys infected other monkeys.—C. Nicolle—Annals de l'Inst. Pasteur, *per* L. ii./10,182.

Ætiology. The fever can be excited in apes by injection of the blood of a patient suffering from “tabardillo,” which is typhus as it occurs endemically in Mexico, and the virus uncultivable and invisible, even with dark ground illumination, did not pass through a Chamberland or Berkefeld filter. One attack of fever produced by inoculation protects against a second infection. Nothing has been grown from the blood on media. Lice—*pediculi vestimentorum*, are thought to carry the infection.—L. ii./11,172. See also B.M.J. i./13,64.

Collected studies on typhus fever.—L. i./13,1172.

Bacillus Vaginæ, Doderlein's.—

An aerobic organism, Gram –, often feebly +, constantly found in the normal vaginal secretion in adults. Facultative anaerobe, non-motile, non-pathogenic.—Gould.

In a series of examinations of the vaginal secretion in infants this organism was absent. In more than half the cases (ranging from 30 minutes old to 13 days) the fluid was sterile. The reaction of the secretion is (normally) acid in the majority of cases,—not due to action of micro-organisms. Amongst the organisms found were a yellow *Staphylococcus liquefying gelatin* and white *Staphylococci* not liquefying.—P.R.S.M. Obst. Sect. Nov. 10, 26.

B. Vaginæ is the only definite micro-organism of the vagina. It plays the important role of preventing the development of other micro-organisms, especially those of a pathogenic kind by the production of Lactic Acid—B.M.J. ii./10,1222.

Weil's Disease.—The term would be desirably abolished. For cases of the kind in which no specific spirochete or other infection are found it would be better to use the term **hæmorrhagic infective jaundice**. A form of hæmorrhagic infective jaundice has been called variously Mediterranean yellow fever, Weil's disease, spirochaetosis icterohæmorrhagica, etc., which is unscientific.—W. H. Willcox, B.M.J. i./19,707.

Sp. icterohæmorrhagiæ made its appearance in 1916 in Flanders as the cause of a form of febrile jaundice.—A. Stokes and J. A. Ryle.—B.M.J. ii./16 413; E. W. Andrewes, i./17,830; Lord Bertrand Dawson, ii./17,345; see also Sir W. Herringham, i./19,20.

The spirochete causes epidemics in Japan.—B.M.J. i./16,627.

Jaundice, Epidemic, of Campaigns and of Tetrachlorethane poisoning. In the former avoid excess of protein. Give in a mixture Sodium Bicarbonate 20 grains, Potassium Citrate 30 grains, Sodium Sulphate 30 grains, thrice daily. Calomel should not be given in repeated doses. Treatment in the latter varies as the case is (1) early (pre-jaundice), or (2) with marked toxæmia, or (3) not marked.—W. H. Willcox, B.M.J. ii./16,297.

Whooping Cough.—Bordet's *Bacillus*.—A cocco-bacillus, non-motile, Gram-negative, staining feebly, regarded as causative of whooping cough, has been isolated. Cultures of the organism were found to be specifically agglutinated by the serum of children suffering from. Agglutinating reacting of the serum is not strong.—B.M.J. ii./09,323,1062 (complete paper); L. ii./09, 471. See also Vol. I. p. 905 and Therapeutic Index.

Yaws. *Syn. Framboesia*. A contagious inoculable disease characterised by an indefinite incubation period followed usually by fever by, rheumatic pains, and by the appearance of papules which generally develop into a fungating, encrusted, granulomatous eruption. It is believed to be caused by *Treponema pertenue*.—Manson. **Treatment.**—Sodium Bicarbonate in 1 drachm doses, together with Copper Sulphate locally. Potassium Iodide

10 to 20 grains for adults, 2 to 5 grains for children thrice daily. If anæmic, Ammonio-Citrate of Iron. Locally Mercuric Nitrate Ointment (1 in 3 Vaseline).

FRAMBÆSIA in Ceylon. Potassium Iodide in large doses best routine treatment; Atoxyl, Sodium Cacodylate, and Quinine Cacodylate also useful.

Novarsenobenzol has a rapid and remarkable curative action in every stage of the disease.—Manson. See also Arsenobenzol.

Yellow Fever.

The Americans, Reed, Carroll, Agramonte and Lazear established that Yellow Fever is transmitted by *Stegomyia calopus* (*S. fasciata*). The virus can be transported from one place to another. For its development it requires a temperature of over 75° F. It ceases to spread below that. Usually it is a sea coast disease. The germ cannot be cultivated on ordinary lines and it is not a visible bacterium. It is a filter passer. The mosquito is the intermediary but it is not transferable by *recently* infected mosquitoes. The parallellism between the etiology of yellow fever and malaria is very complete. The germ is probably of protozoal nature. One attack generally confers permanent immunity.—Manson.

For a descriptive account see A. E. Shipley, B.M.J. i./15,921.

Serum of convalescent patients and animals promising.—B.M.J. ii./19,48. Noguchi's Researches, *ibid.* 283.

OLDER REFERENCES :—

History of Yellow Fever.—It is endemic amongst natives of the coast towns. Rational precautions of segregation and *Stegomyia* destruction necessary to prevent great set backs to commercial progress in West Africa. Evidence is overwhelming in favour of the disease being endemic on the West Coast of Africa, and of its having been repeatedly mistaken for other diseases (often called "bilious remittent fever") or entirely overlooked, and of its being kept up in a mild form by the natives and infected by *Stegomyia*.—B.M.J. i./11,491,249,301.

If not a natural immunity, many natives in West Africa have at least an acquired one,—probably through mild and frequent attacks in childhood. The endemicity considered by many as an established fact. Cases are described of "whites" usually having some slight "disorder" on their first visit to places endemic to yellow fever, many factors point to this "disorder" being a mild form of yellow fever, which would account for the immunity enjoyed afterwards by these people.—B.M.J. ii./11,1263; L. ii./11,459. Etiology of, L. i./12,183.

Yellow fever in Yucatan (Mexico). The natives are assumed to be immune from childhood. Relationship of *paraplasma flavigenum* to the disease — L. ii./12,1812,1830.

A resume of researches on, *vide* L. i./14,1408

Dengue.—Amosquito-conveyed specific fever, usually as a rapidly spreading epidemic. Sudden primary fever of about 3 days' duration then an apyrexial period and again a milder secondary fever with rubeloid eruption. Rheumatic-like pains in the febrile stages. *Stegomyia calopus*, not *Culex fatigans*, is the vector.—Manson.

Points of similarity between Y. Fever and Dengue. It is only quite recently (1916) that *stegomyia* has been proved to be a vector of dengue (Burton Cleland, Bradley and McDonald—three Australians). *Culex fatigans* is not the only transmitter if a transmitter at all.—B.M.J. ii./17,105.

STAINING METHODS.

Gram's method of differentiating Organisms in Film Preparations:—

1. Aniline-Gentian-Violet 3—5 mins. 2. Without washing, Gram's solution $\frac{1}{2}$ to 1 min. 3. Pour off Gram's solution, wash in water, rinse with alcohol, three times, each of 10 seconds duration. Counterstain with neutral red 0.5% or weak Carbol-Fuchsin $\frac{1}{2}$ minute. 4. Wash in water. Dry.

Gram's Iodine solution has the formula:—Iodine, 1 Gm.; Potassium Iodide, 2 Gm.; Water, 300 Cc.

NOTE.—Aniline-Gentian-Violet is prepared by adding 1 part of a concentrated alcoholic solution of the dye to 9 parts of a filtered saturated solution of anilin oil in water (solubility about 1 in 30). P.G.V. directs 7 Cc. of the Saturated Alcoholic Solution of Gentian Violet with a further 10 Cc. of Absolute Alcohol to be added to 100 Cc. of filtered Aniline-Water. This may overcome 'muddiness.'

Gram-Eosin Method for Sections.—1. Place a little alcohol on section $\frac{1}{2}$ min. 2. Cover with filtered Aniline-Gentian-Violet 10 mins. 3. Gram's solution, 3 mins. 4. Decolourise in Alcohol. Wash in water. 5. Stain with Eosin 1—2 mins. Wash in water. 6. Dehydrate with Alcohol. 7. Clear with Xylol, mount in Xylol Balsam.

Eosin - Gram - Weigert - method.—Eosin (5% aqueous) 5 to 10 mins. Wash in water. Aniline-Gentian-Violet 10 minutes without washing. Gram's iodine solution, 3 minutes. Wash in water. Blot, dehydrate, and differentiate in aniline oil until pink colour returns. Clarify in Xylol and mount in Xylol Balsam. This method is preferable to the Gram-Eosin method, as aniline oil is more gentle in decolorising action than the alcohol used in the latter

For **Jensen's Modified Gram's Method** using stronger Iodine Solution and Neutral Red as counterstain, see p. 489.

A simple stain for sections is:—

Carbol Thionin Blue.—Thionin Blue, 0.65 Gm.; Absolute Alcohol, 3.5 Cc.; Phenol Solution, 5% 39 Cc.

Carbolic Methyl Violet. *Syn.* Carbol-Gentian-Violet.

This is better than Aniline-Gentian-Violet especially in hot climates. The Methyl Violet Stain is:—Melted Carbolic Acid 12.5 Cc., Absolute Alcohol 25 Cc., Methyl Violet 6 B. 1 Gm. Dissolve, keep in a warm place 24 hours and filter. Fix the smear with Alcohol. Place 3 or 4 drops of Distilled Water on the smear and one drop of the stain. Then Gram's solution in the usual manner. Counterstain with Safranin or weak Fuchsin.—B.M.J.E. i./13,96.

Aniline dyes exhibiting the most powerful lethal action on a typically Gram + staining micro-organism (*Staphylococcus*) are those which can be used with the greatest success by the method. Substances having special affinity for the dyes in question are assumed to be present in Gram + staining organisms and as Iodine plays a special role in the Gram reaction, special examinations with *lipoid* substances gave interesting data. (1) Treatment of *B. Coli* with Lecithin Emulsion may make it Gram + staining. Boiling *Staphylococci* with Ether renders them almost entirely non-Gram staining.—Jl. Path. & Bact.—July, 1911, p. 146.

We found that non-Gram staining organisms were decolorised in periods varying from 2 to 5 minutes, using *strong Methylated Spirit*, and that Gram staining organisms were not decolorised even after one hour's washing. If weaker spirit, e.g. 60%, is used, organisms that were not decolorised in an hour with strong spirit may be almost decolorised in ten minutes, therefore the *strongest Spirit is absolutely necessary*. The Iodine treatment should be for at least 5 minutes, in fact it cannot be overdone in a film preparation. We should recommend 10 minutes washing with the spirit. See also p. 489.

List of some pathogenic and common non-pathogenic organisms stained and not stained by Gram's method:—

A. STAINED (' + ').

Staphylococcus, all varieties
 Streptococcus pyogenes.
 Micrococcus tetragenus.
 Fraenkel's pneumococcus.
 Bacillus Acne.
 „ anthracis.
 „ botulinus (Acne).
 „ diphtheriæ.
 „ enteritidis (Klein).
 „ Oppler-Boas.
 „ pseudo-diphtheriæ
 „ xerosis.
 „ tuberculosis.
 „ Smegmæ (?—)
 „ lepræ.
 „ subtilis.
 „ Welchii.
 „ tetani.
 „ 'Reading.'
 Aspergillus.
 Sarcinæ, all varieties.
 Yeasts (Blastomycetes).
 Ringworm Fungi.
 Streptothrix of Actinomycosis.
 „ of Madura disease.
 Trench fever coccus.

B. NOT STAINED (' - ').

Bacillus mallei.
 „ typhi abdominalis.
 „ coli communis.
 „ dysenteriæ (Sniga and Flexner).
 „ enteritidis (Gärtner).
 „ pestis.
 „ pyocyaneus.
 „ influenzæ.
 „ Friedländer's Pneumo;
 „ malignant œdema.
 „ symptomatic anthrax (Charbon).
 „ prodigiosus.
 „ proteus vulgaris.
 „ fluorescens liq. and non-liq.
 „ Smegmæ.
 „ soft sore.
 „ whooping cough.
 Diplococcus intracellularis meningitidis.
 Diplococcus Catarrhalis.
 Gonococcus.
 Spirillum cholerae Asiatic
 „ Metchnikovi.
 „ Finkler and Prior.
 Spirochetes of Syphilis, Relapsing Fever, Vincent's Angina, and other parasitic protozoa.

Nitrobacterin.—Nitrifying bacteria on the nodules of leguminous plants (peas, beans, clover, &c.) are cultivated under this name for enriching soil. The sequence of crops is turnips, barley, clover, wheat. Practice has been ahead of science. Some other valuable and concise information as to the bacteriology of fermentation, caseination, &c.—B.M.J. ii./07, 1764.

Alkalinity of the soil is a *sine qua non* for the growth of bacteria—which produce acid in their proliferation. Importance of alkalinity for plant growth. C.D. ii./16, 740.

Semen Test.—The presence of spermatozoa may be detected by evaporating a drop of the liquid from the moistened stains, fixing it by a flame and staining with eosin and methyl green. At the base of the head of the spermatozoon is a hemispherical portion which stains green, while the anterior part and tail stain red. Some prefer the use of methyl green alone. Ehrlich's Hæmatoxylin (stain 5 minutes) wash in distilled water, then in tap water until blue, and counterstain with Eosin solution (2 or 3 minutes), also gives good results.

Semen Stains may be identified by boiling (fabrics) 2 minutes in a watery solution containing Tannin $\frac{1}{2}\%$ and Sulphuric Acid 1 per 1,000, then wash with strong Ammonia Solution 1 in 400 for 2 minutes, immerse 5 minutes in a solution of potassium bichromate 1 in 10,000 with 1 in 1,000 Sulphuric Acid, transfer for 2 minutes to 2% Potassium Cyanide Solution; finally rapidly wash in distilled water. Scrape and tease up on a slide, dry, fix and stain.—B.M.J. ii./06, 1261, 1843.

Semen Stained by Eosin.—Cut a portion of the cloth $1 \times 1\frac{1}{4}$ inch, soak in Müller's Fluid 24 hours preferably at 37° C. in incubator (e.g., in covered watch glass). Wash in several changes of water to remove dirt as also fixing fluid. Place the cloth, one end held in forceps, for a moment on blotting paper to remove excess of moisture, then lay flat on centre of micro slide. Pass edge of scalpel or of another slide with a fair amount of pressure from the end of the cloth fixed by the forceps, to the other. Repeat

on the other surface, turning the cloth over on the same portion of the slide. The end of the cloth is then placed, with the forceps between finger and thumb, the rest being pleated up by the same means and tucked in so that firm pressure of the tips of forefinger and thumb causes a drop of liquid to fall which add also to the slide. Dry in incubator, and stain three minutes with 1% Eosin solution.—B.M.J. ii./08,501.

Picric Acid Test for.—Mix the suspected semen, whether liquid or dry, with a little water, add a drop of Glycero-Solution of Picric Acid containing a little alcohol—if human semen, yellow needle crystals, visible under the microscope.

Preparation of Sections before Staining.

Rapid Paraffin Method for small pieces of tissue. Fix in Alcohol two hours, Acetone 1 hour, Anilin Oil $\frac{1}{2}$ hour, Xylol $\frac{1}{2}$ hour in the Incubator at 37° C.—then in Paraffin at $\frac{1}{2}$ hour 70° C.

Slow Paraffin Method.—Fix in Alcohol (not Formalin) 2 days, then place in Xylol 3 to 5 days.

N.B.—Tissues fixed in Formalin or Müller's Fluid must be thoroughly soaked or the sections will not adhere to slides. Use fresh (unused) Paraffin for embedding. To fix frozen sections to slide damp off excess of water with filter paper, flood three times with Alcohol, then once with 0.5% Celloidin in Acetone. Then stain.—Wyatt Wingrave.

Rapid Gum-freezing.—Place tissue into boiling Müller's Fluid or Formol-Müller, or plain water. Boil 3 minutes, wash in water; freeze in Gum with Ethyl Chloride or by Carbon Dioxide.

Zenker's Fluid.—Bichromate of Potassium 2.5 Gm., Sulphate of Soda 1 Gm., Corrosive Sublimate 5 Gm., Glacial Acetic Acid 5 Cc., Distilled Water 100 Cc.

Müller's Fluid.—Potassium Bichromate $2\frac{1}{2}$, Sodium Sulphate 1, Water 100. Used in histology for hardening tissues.

Formol-Müller Fluid.—Müller's Fluid 100, Formalin 5.

Erlitzki's Fluid.—Potassium Bichromate 5, Copper Sulphate 1, Distilled Water 100,—used in the same way as Müller's Fluid. Microscopical examination of the eye, Method and formulæ.

Transparent method for bony specimens.

Dehydrate in successive baths of Alcohol and Acetone, Anilin Oil, Xylol, and Liquid Paraffin.

Formalin Preservative Solution.—Formalin (40%) 78, Potassium Acetate 3, Potassium Nitrate 1, Glycerin 40, Water 140.

This has the advantage of retaining the colour of pathological specimens.

Method of cutting frozen sections of fresh tissues for immediate microscopic diagnosis during operations. Lockwood & Shaw.—B.M.J. i./07,127.

Frost's Solution for preserving anatomical specimens. Sodium Fluoride 80, Chloral Hydrate 80, Potassium Acetate 160, Cane Sugar 3,500, Saturated Thymol Water 8,000. The specimens retain life-like appearance.—L. i./12,579.

Farrant's mounting medium.—Gum Acacia, best small, 32 ozs., wash well with 6 ozs. of water in two or three lots and dissolve in 40 ozs. of boiling water with constant stirring. Strain through muslin and add Arsenious Acid 1 drachm in Glycerin 40 ozs., heat gently to clarify.

Apathy's Gum Syrup. For ringing Slides.—Picked Gum Arabic, Cane Sugar (ordinary, not candied), Distilled water, of each 50 Gm. Solve in water, and add 0.05 Gm. Thymol. Render alkaline with a little Sodium Carbonate. This sets in about 15 to 30 minutes in a warm room. The use of this with other precautions, helps in preventing slides from fading.—L. i./11,877.

CULTURE-MEDIA FOR BACTERIOLOGICAL INVESTIGATION.

Nutrient Broth.—Boil 'Lemco' 5 Gm., Peptone 10 Gm., Sodium Chloride 5 Gm., Water 1,000 Cc. Make faintly alkaline with dilute Sodium Carbonate solution, using litmus as indicator, and filter through grey paper. The broth thus prepared may be run into specially cleaned test-tubes, about 5 Cc. into each. These are now plugged and sterilised at 100° C. for a quarter of an hour on three successive days, or the broth may be converted into other nutrient media.

The following is sometimes used:—Beef (or horse, &c., flesh) 450 Gm freed from fat and minced, is extracted for twenty-four hours with cold water 1,000 Cc. The albumin is coagulated by heat and strained off. The resulting extract is boiled ten minutes with Sodium Chloride 5 Gm., and Peptone (in powder) 10 Gm., with occasional shaking. Finish as above after rendering alkaline.

Standardisation.—The broth and the gelatin and agar media made from it are acid to phenolphthalein, but are frequently neutral or even alkaline to litmus—this latter not being sensitive to many of the weak organic acids present in the meat extract. The medium is, therefore, standardised with $\frac{N}{10}$ soda in the presence of phenolphthalein. The reaction of a medium is usually expressed by the number of Cc. of normal alkali required to be added to 1 litre of medium to render it exactly neutral to phenolphthalein, *e.g.*, '+10' indicates that 10 Cc. of N soda have to be added to neutralise it. *This reaction has been found best for general bacterial growth, and is the standard employed.* The rule for standardising, therefore, is to subtract 10 from the number of Cc. of normal soda that must be added per litre; for example, if 10 Cc. of a medium require 1.2 Cc. of $\frac{N}{10}$ soda, then 1,000 Cc. = 12 Cc. $\frac{N}{10}$ soda. The medium is now neutral to phenolphthalein, but distinctly alkaline to litmus. Then subtracting 10 Cc. from 12 we have 2 Cc. of $\frac{N}{10}$ soda to be added to 1 litre of medium.

Glucose Broth consists of Nutrient Broth with the addition of 1 or 2% of pure anhydrous glucose added after final filtration, but prior to sterilisation.

Glycerin Broth.—Nutrient Broth containing 5 to 8% of Glycerin.

Litmus Broth consists of the addition of a sufficient quantity of Litmus solution to neutral broth to render it distinctly blue in colour.

Nutrient Gelatin.—Broth 1,000 Cc., gelatin 125 Gm. Melt in steamer and clarify by adding the white of one egg, to which a little water may have been added, render faintly alkaline, place in steamer to make quite hot, and filter in the same, leaving the portion containing the coagulated albumin, which will have subsided, carefully until the last. Run the medium into tubes, about 5 or 8 Cc. into each according as to whether 'slopes' or 'stab' preparations are required. Sterilise on three successive days.

Glucose Gelatin consists of nutrient gelatin to which 1 or 2% glucose has been added after filtration. For the cultivation of anaerobic organisms and to observe gas formation. Must not be sterilised in the autoclave.

Nutrient Agar.—For this medium the following gives satisfactory results:—Nutrient broth 1,000 Cc., powdered agar-agar 20 Gm. (passed through a drug-mill and made as fine as possible); melt in the steamer, or better in an autoclave, allow to cool slightly, or, if time is an object, cool by shaking under a stream of cold water from the tap; add white of two eggs, *make just alkaline*, boil in the steamer or autoclave twenty minutes, and then transfer to a tall beaker; allow to get quite cold, remove the solid mass from the beaker, and cut off the bottom of the block of jelly containing the coagulated albumin and sediment. The remainder is again thoroughly melted in the autoclave or steamer, and will then filter well (in the steamer). It may be poured into tubes, and sterilised in the autoclave for a quarter of an hour under a pressure of at least two atmospheres—or, in the steamer on three successive days. Instead of cutting off the sediment on setting, it may be kept out by straining the hot liquid through butter-cloth previous to filtration.

N.B.—The white of egg should be added when the medium has almost set—*i.e.*, as cool as possible—as the albumen coagulates at 65° C. and it acts purely mechanically by carrying down with it the particles of suspended matter.

Neutral Red Egg Medium (Fleming's) for cultivation of Staphylococci from the urine. Differs only from Dorset's in that it contains 0.005% Neutral Red as an indicator.

Dorset's Egg Medium.—The contents of 4 fresh eggs are well beaten and 25 Cc. of water added, the mixture strained through muslin to remove air bubbles, then tubed (or plated) and heated 4 hours at 70° C. It may be further sterilised by heating in the autoclave for 5—10 minutes at 105° C. The addition of sufficient basic Fuchsin to colour the medium slightly pink enables early growths to be more easily seen.—M. & R., 6th Edn., p. 45.

H. Warren Crowe's procedure for the preparation of Neutral Red Egg Medium is as follows:—He places the requisite amount of Neutral Red (25 Cc. of 0.01% aqueous solution of Neutral Red for each egg) in a flask plugged

with wool, and autoclaves it together with two rubber corks, one with two wires or glass rods long enough to reach within one inch of the bottom of the flask, the other carries two tubes, a short one reaching two or three inches from the cork on the inside and fitted with a hooded pipette on the outside and one reaching to the bottom of the flask, the outer portion being bent to form a recurved angle and plugged with wool. He then soaks the eggs in spirit, flames them and cracks them at each end with long sterile sinus forceps, breaking the yolk by pushing them in and opening them inside the egg. When all the eggs are in, the rubber cork with the rods is placed in position and the contents of the flask emulsified by shaking (the rods serve this purpose). The flask is then inverted, suspended and allowed to stand until the whole of the particles of egg-shell, *etc.*, have settled below the level of the shorter tube. The medium is then ready to run into tubes or plates, which are finished by heating to 90° C. for half an hour.—P.R.S.M., Path. Sect.—Vol. VI. p. 117; L. i./₁₃, 1377. See also *Rheumatism, Vaccine Therapy, Vol. I.*

Musgrave's Medium.—Beef Extract 0.5, Sodium Chloride 0.5, Agar 20, Tap Water to 1,000. Alkalinity minus 1 gives a growth of fairly constant characters. Employed in growing coli-form bacilli from patient's bowel in making autogenous vaccine (for treating goitres).—L. i./₁₃, 1371.

Blood Agar is prepared by streaking nutrient agar with blood drawn under the strictest aseptic precautions from the finger, or from a freshly-killed animal. It may be used in the 'slope' form or as plates. The gonococcus grows favourably on this medium.—N.B.—For Gonococci and Pneumococci use the patient's blood if possible. See also *B. Influenzæ*, Fleming's Method, p. 491.

Endo's and Hiss' Medium, vide p. 552.

Chocolate Medium.—Bullock's Blood Trypsin—Agar (H. W. Crowe). For Meningococcus, see *Cerebro-Spinal Fever*, Vol. I., p. 852.

Glucose Agar consists of nutrient agar to which 1 or 2% glucose has been added after filtration. In the upright form is used also for deep stab cultivations of anerobic bacteria. Must not be sterilised in the autoclave.

Glycerin Agar is nutrient agar with the addition of 5 to 8% of glycerin. Is a satisfactory medium for the growth of *Bacillus diphtheriæ*, *B. tuberculosis* and *Streptothrix actinomycosis*.

Maltose Agar.—Maltose 12, Peptone (in powder) 3, Agar 3.9, Water 300. This is prepared in the customary manner, but the product is not neutralised. Blaxall's formula is Maltose 12, Peptone 1½, Agar 9, Water 300; For ringworm cultivation.

Peptone-water (Dunham's Solution).—Peptone 5 Gm., sodium chloride 10 Gm., tap water 1,000 Cc.; boil in the steamer one hour, filter, and sterilise. Not necessary to render alkaline. Used for the production of the indol reaction as one of the aids, for example, to distinction of *B. typhi abdominalis* and *B. Coli*. It was originally utilised for cholera-diagnosis.

Casein as a substitute for Peptone for bacterial culture. The amino-acids required are produced by tryptic digestion of Casein (Lait proto, No. 6). Standardisation is effected by employing phenol-sulphone-phthalein solution. The broth is cheaper than peptone and is of constant composition. It is useful for making into Agar culture medium and for special media, *e.g.* Endo's, *etc.*—S. W. Cole & H. Onslow, L. ii./16, 9. See also Cole & Onslow's Tryptic Agar, pp. 488 and 549.

Potato.—Large specimens are thoroughly cleaned and cut into 'half-cylinders' with a potato-borer. The brown peel is removed and the pieces soaked overnight in water to wash off excess of starch. Wide test-tubes (1 inch by 6 inches) are plugged and sterilised, and a little distilled water is placed with each half-cylinder in the tubes. The water prevents drying up in sterilising, which is effected by heating on three successive days. Must not be sterilised in the autoclave.

Potatoes prepared as above may be soaked in 5% glycerin water for several hours previous to putting into tubes. These are very useful for the cultivation of the tubercle bacillus.

Milk.—The cream is skimmed from good cows' milk, and the resulting 'skimmed' milk sterilised in the steamer for ½ hour on three successive days.

May also be drawn direct by means of a catheter into sterile vessels with the strictest aseptic precaution. Organisms are said to grow better in this than in milk which has been heated.

Litmus Milk.—The above—with a small proportion of Litmus solution added. Used for detection of acid formation.

Blood-serum.—The serum is separated from fresh blood obtained from the jugular vein of the sheep. It is centrifugalised and filtered through a sterile Chamberland filter. (The candle is heated in a muffle-furnace, or in a bright fire, if it has been previously used for the same purpose.) The filtrate may then be poured into sterile test-tubes, plugged—and inspissated, first at 80° C., then at 60° C., and the latter temperature is maintained eight to twelve hours, or more if necessary. The medium is finally tested after capping by incubating at 37° C. for twenty-four hours to ensure sterility.

Löffler's Blood Serum.—This consists of ordinary 'Serum' 3 parts mixed with neutral peptone bouillon 1 part with 1% grape sugar added to it. Tubes are filled and sterilised as under Blood Serum.

Elschnig's Medium is a fluid one in which reliance is placed for detecting pneumococci. It consists of 1 part of Horse Serum and 3 parts of bouillon without Peptone.—*Glas. Med. J.*, Feb. 1913

Sterilisation of Serum by adding Chloroform 0.5% with addition of heat—one hour at 45° C. in stoppered bottles. Useful method for making Blood Agar, Serum Agar, etc.—*P. Fildes, L. i./17, 492.*

For other media described in the Text consult the Index.

EMBALMING.

If it is impossible to make the autopsy at once, preservative may be injected into the body until such time as convenient; about 300 Cc. of 5% solution of Formalin suffice. It is introduced through the arteries (arterial embalming) or a coarse trocar and cannula may be driven deeply into the tissue and the cavities and organs injected (cavity embalming).

Perchloride Embalming—The former method is usually practised by opening one of the large-superficial arteries, as the femoral, and forcing the fluid through the vessels. Nauwerck uses the following—500 Cc. injection syringe; long cannulæ of different calibres, with pear shaped ends and with stopcocks or, preferably, with double stopcocks; strong twine; scalpels, scissors, forceps, grooved director, hæmostats, an aneurism-needle, and ordinary needles; basins and buckets; several packages of absorbent cotton; cloths and sponges; and 10 litres of a 10% solution of mercuric chloride. His method of embalming is begun by exposing the lower part of the abdominal aorta and the two iliac arteries. Two ligatures are placed beneath the aorta about two finger-breadths apart, and the aorta is obliquely incised to allow the entrance of the cannula, which is secured by tying the distal ligature over it. The injection into the upper part of the body is then begun carefully and slowly, pausing occasionally when the counter-pressure becomes too great. About 3 litres are injected or less, depending upon the appearance of swelling of the face, seen first about the eyes and chin. The cannula is removed, both proximal and distal ligatures are tied, and the aorta is cut through. In like manner a litre of the solution is injected into each leg through the common iliac artery. A cannula with a double stopcock can be used to inject both the upper and lower parts of the body at the same time. The mesentery is ligatured, and the intestines, from the beginning of the jejunum to the end of the sigmoid flexure, are removed, opened, washed out, and put in a 1% solution of mercuric chloride, and later replaced in the abdominal cavity, wrapped in sublimate wool, or where practicable, disposed of by cremation. The stomach, duodenum and rectum are cleaned out with sublimate solution and packed with sublimate wool. The bladder, vagina, external ear, and nose are similarly treated. The abdominal cavity is carefully wiped with a cloth wrung out of the perchloride solution and dried, and the abdominal incision is sewn up. The surface of the body, with the exception of the hair, is also wiped with the solution and dried. If this method fails, Nauwerck injects into the carotid and axillary arteries.

Formalised Arsenical Embalming Injection.—Hewson recommends the following injection for embalming—Sodium Arsenate 40, boiling water 157. Boil until dissolved and add glycerin 40, formalin 2 or 3. About 2 and one-half gallons are introduced into an artery—say the common carotid—by gravity, openings having been previously made in the toes or in several of the veins if they be distended with blood. After the injection the body is thoroughly greased, covered with paper, bandaged and placed in cold storage until wanted for dissection. *Caution*—These solutions are caustic in action on the hands.—*Cattell's Post-Mortem Pathology*

PROPRIETARY MEDICINES.

In the following list we provide the approximate composition of Proprietary Medicines—several are mentioned incidentally in the text (all are indexed in the General Index). The '*British Medical Journal*,' the '*Lancet*,' etc., have from time to time published results of analyses, and reference to their pages is made below in each instance. Considerations of space have usually obliged us to mention only the ingredients which have undoubted therapeutic effect. The reader is referred to the original sources for further details. With regard to the great majority of medicines, it should be noted that there are other ingredients which, though for the most part flavourings or colourings, may in some cases be considered to be medicinal. Our list must not be considered complete, though care has been exercised to state therein what appear to be the chief ingredients. The composition of some Proprietary Medicines may be found to vary from time to time. Again the composition of a proprietary article in one country does not necessarily convey a correct impression of articles sold under the same name in other countries.—B.M.J. i./10,339. The majority of those to which we give B.M.J. references are described in '**Secret Remedies, what they cost and what they contain** (1909),' and in '**More Secret Remedies** (1912),' issued by the British Medical Association, to which we would refer our readers. In some instances we give these books as our only references.

Comparison of conditions of Sale of Patent Medicines in various countries.—L. ii./12,1672.

Australian Practice.—Wording respectively permitted and not allowed in advertisements and descriptions of proprietaries.—C.D. i./13,912; B.C.D. i./13,564.

New Zealand QUACKERY PREVENTION ACT, 1908—any person commits an offence who publishes any statement intended to promote the sale of any article as a medicine for prevention or cure of any ailment or physical defect which is false in any material particular.—Gadd.—B.M.J. i./11,767. We understand, however, that there is a provision in the Act that action can only be taken by Government permission which distinctly detracts from the utility of the measure.

Desirability of enforcing the labelling of Proprietary Medicines and Foods, with a full statement of contents as required by the Pure Food and Drugs Act in **America.**—'State Regulation of Proprietary Medicines and Foods.'—B.M.J. ii./08,574.

The American Medical Association drew up regulations for controlling trade names of pharmaceutical and chemical preparations and issued same to manufacturers of medicinal products.—Chicago, March 15/1912.

U.S.A. Proprietary Medicines.—The Department of Agriculture through the Bureau of Chemistry has issued details as to Claims of Therapeutic Effects, Indefinite and Sweeping Terms, Testimonials, etc., for guidance as to wording of labels permissible under an Amended Food & Drugs Act. The names, e.g. "Nerve Tonic," "Lung Balm," "Kidney Pills," are objected to. "Guarantees" as to refund of money also not permissible.—B.M.J. i./15,24.

Patent Medicines and Revenue.

Net receipts from Medical Stamp Duty for the year ending March 31st, 1913, was £328,319 (£325,420 in England, and £2,899 in Scotland), as against £327,857 for 1911-12. The duty does not extend to Ireland.—L. i./13,1562.

The Inland Revenue Authorities hold that an advertisement in a technical journal which does not go to the public does not constitute an advertisement to the public.—C.D. i./13,928.

Dr. Cox, before the Select Committee on Patent Medicines (1912) made the statement that £2,500,000 had been paid by the public since 1908 on Patent Medicines.—C.D. i./12,923.

"The Government reaps a very rich harvest from secret preparations. They have a Government stamp on them, and the Treasury gets many thousands a year out of them,—wrongly, I think. The Government does not think so, however."—Coroner Dr. F. J. Waldo.—P.J. ii./09,303.

Administration of Adulteration Laws.—Sale of Food and Drugs Acts with regard to Proprietary Medicines,—they affect these articles very little. Legislature to make a fresh start and create a new body.—A. W. J. MacFadden, Chief Inspector of Foods under L.G.B.—P.M.C.E., C.D. i./13,874.

The provision of qualified medical advice for the 14,000,000 who come under the National Insurance Act will cause a decrease in the sale of Proprietary Medicines.—C.D. i./12,928.

In B.M.J. of May 27th, 1911, papers on 'Cancer Credulity and Quackery' (see also Cancer Chapter), 'Bone-setting,' 'Quackery and Female Complaints,' 'Skin Diseases and Cosmetics,' 'Unqualified Practice,' 'Quackery in Rural Districts,' 'Quackery in the Past,' 'Herbalists and Medical Practice,' 'Unqualified Practice in the Eye of the Law,' 'Unqualified Practice through the Post,' 'Quackery in Aural Diseases,' 'Quackery in France,' 'Causes of Quackery,' etc., will be found.

The British Medical Association, the British Pharmaceutical Conference, and other Associations joined issue with the Parliamentary Committee on Food Reform to bring the whole subject before a Royal Commission.—P.J. ii./11,69.

The House of Commons appointed a **Select Committee to Enquire into the conditions prevailing in the United Kingdom regarding sale of Patent and Proprietary Medicines.** The Royal College of Physicians, London, made certain recommendations as to the exact composition of the contents of bottles, etc., being printed thereon, and that manufacturers shall not be allowed to print names of diseases or symptoms on same. c.f. C.D. July 1, 1911. We may point out that in certain countries legislation on these lines has been found inoperable.

The Committee met for the first time May 9th, 1912, and received evidence from the Board of Inland Revenue (per Sir N. Highmore) also on May 16th, 1912.—c.f. B.M.J. (May 18th) i./12,1140; C.D. May 18th, 1912.

Subsequently numerous meetings were held and a large number of persons were examined. We have embodied the evidence where of sufficient interest under the appropriate headings. At the same time we have omitted a large number of the preparations which found a place in previous Editions. Recent careful enquiry has shown us that these were in very little demand in commerce.

It should be understood that the authors have no interest one way or the other in providing the following information. It is solely for the guidance of medical men, analysts and pharmacists, and it is not given with any ulterior motive in view.

The authors do not claim to have completely stated all the pros and cons in the matter and the conflicting statements of the analysts giving evidence in the Proprietary Medicine Committee Enquiry. The volumes of the various scientific journals are available for those requiring the information, but even these do not give a complete report of all the evidence.

With regard to the general body of patent medicines, one of the most vexed questions was that of the publication of formulæ. Disclosure, not on the label, but to some State Department (either a new central body or one of the existing offices) will probably represent the desire of a section of the Committee. The publication of formulæ would be of no value to the public, while holding out prospects of incalculable harm to proprietors; and it may be taken for granted that should disclosure be insisted upon as essential it will be to a Government body who would be under the strictest obligation to preserve secrecy in regard to the composition of the articles.—C.D. i./13,943.

Publication of formulæ would be of very little advantage to those whom ostensibly the suggestion is intended to protect. Self-drugging would not be reduced. Censorship of advertisements would be an extremely difficult matter. Supervision of constituents would be impossible.—Umney, P.M.C.E.—P.J. ii./12,582; C.D. ii./12,721.

The **Report of the Committee**, issued Aug., 1914, obtainable from Wyman & Sons, Fetter Lane, E.C., found that the existing law offers no check to gross abuse of the public and **recommended the formation of a Government Department—a Ministry of Public Health when created, in the meanwhile the Local Government Board, to regulate the Advertisement and sale of Patent, Secret and Proprietary Medicines and Appliances.**—P.J. ii./14,346; C.D. ii./14,339; c.f. L. ii./14,653,702.

The B.M.J. published a request for information as to injury caused by Proprietary Medicines, but most of the replies were too general to be of use in the Patent Medicine Enquiry.—C.D. i./12,929.

An **"Index and Digest of Evidence"** of the Report of the Select Committee on Patent Medicines has been issued officially (Wyman & Sons, Ltd., 11d.). It is a useful summary of the bulky Report.

In selling **proprietary medicines containing poisons** the retailer takes the entire risk—he may sell a poison quite innocently, but he would be liable.—P.M.C.E., C.D. i./12, Ind. fol. 24.

A patient cannot **'patent'** a **prescription** he receives from a consultant. The patent would not be valid, as the patient would not, for one thing, be the "true and first inventor" of the prescription.—E. J. Parry,—P.M.C.E., C.D. i./13,560.

Difficulties of Analysis.—Arnica, Bryonia and Buchu have medicinal effect, but science has not been able to state what the active principles are,—these cannot be discovered with certainty by the analyst. Gentian, Mezereon Hamamelis, Rhubarb and Senna have medicinal effect—in some cases science does not know why. When mixed together it is almost impossible for an analyst to identify them.—P.M.C.E., C.D., July 6/12, Ind. fol. 23.

Six minims of Ipecacuanha Wine in a six-ounce bottle of water would not be detected by an analyst unless he were put on the track.—P.M.C.E. C.D., July 6/12, Ind. fol. 23.

Medicated Wines.—Necessity of stating Alcohol strength on the labels—it is often greater than that in light wines.—Dr. Mary Sturge, P.M.C.E. C.D. i./12, Ind. fol. 5.

'Registration' foreshadowed—disclosure of ingredients of preparations to a Government Department might be an advantage to the manufacturers as giving more definite public recognition.

International Pharmacy.—French regulations bearing on the introduction of foreign pharmaceutical preparations are exceedingly severe. The reciprocity is too one-sided!—B.M.J. i./19,534.

Proprietary Medicines Bill.

Introduced into the House of Lords, July, 1920. Proprietary Medicine means any medicine held out by advertisement, label or otherwise in writing, as efficacious for the prevention, cure or relief of any malady, ailment, infirmity or disorder affecting human beings and

(a) Which is sold under a trade name or trade mark to the use of which any person has or claims or purports to have an exclusive right; or

(b) Of which any person has or claims or purports to have the exclusive right of manufacture or for the making of which any person has or claims or purports to have any secret.

A considerable amount of discussion has taken place on the subject of this Bill, and the expressions of opinion seem to have been more on the side of pharmacists than on the side of the medical profession. The following are a few brief abstracts from recent journals, in particular from the "Chemist and Druggist."

To commence with, in the C. & D., Oct. 16/20, it is stated that at a meeting of chemists a pharmacist expressed the opinion that the Bill is one of the most serious menaces to the liberty and privileges of pharmacists that have ever been devised. The speaker stated further that pharmacists should obviously support legislation in so far as it will prevent fraud in the proprietary medicines trade but not to the extent of depriving chemists of their legitimate rights in the sole interest of the medical profession. The imposing of registration fees upon retail chemists would be a very serious matter.

Exception has been taken throughout the discussion to the disclosure of the ingredients and the proportions of the same in proprietary remedies.

In the C. & D. of Oct. 23/20, is an analysis of the provisions of the Bill as amended in the Committee of the House of Lords, together with numerous suggestions for further amending the Bill. No useful purpose would be served by including here details of penalties, definitions, things forbidden, and so forth, also the list of diseases (cancer, consumption, fits, epilepsy, etc.) contained in what is known as the Major Offence Clause II., as the exact data with regard to contravention of clauses have not been settled.

In the C. & D. of Oct. 30/20, the statement is made that amendments have been submitted to the Ministry of Health which provide only for the declaration of the presence of poisons and of other drugs to be enumerated in a schedule. This is in consequence of overtures made with regard to confiscation of trade secrets. A registration fee of 5s. suggested.

In the C. & D. of Dec. 4/20, a brief editorial occurs in which it is stated that the new Proprietary Medicines Department of the Ministry of Health will be a costly one and on this account alone the Government may yet drop the Bill. The Ministry of Health is famed as one of the most extravagant of the Government Departments.

There is to be no 'formula deposit' but a declaration to be made of drugs in a Schedule.

In the C. & D. Jan. 8/21, is a further article on the subject. The Bill to be re-introduced in February.

Venereal Disease Act 1917—provisions of, see Vol. I., p. 953.

PROPRIETARY MEDICINES WITH REFERENCES.

* *It has not been thought necessary to add the T. M. Nos. in this chapter.*

* **Abbey's Salt.**—(Aperient) Tartaric Acid, Sodium Bicarbonate, Magnesium Sulphate and Sugar.—*L. ii./03,1493.*

* **Alcola** (inebriety).—Three kinds of Tablets.

(P) **No. 1 Tablets** showed the presence of Strychnine 0.12, Caffeine 4.72, Sugar of Milk 86.9, Talc 4.1 per cent. with Starch, a little Gum or Dextrin and a trace of colouring matter. Each tablet would contain 0.007 grain Strychnine and 0.26 grain Caffeine.

(P) **No. 2 Tablets.**—Strychnine 0.2 (approximately), Boric Acid 4.4, Sugar of Milk 82.8, Talc 3.0 per cent., Starch and colouring matter, also a trace of vegetable debris perhaps from some vegetable extract. Each Tablet would contain about 0.011 grain of Strychnine. (P) *If less than 2% strychnine.*

(P) **No. 3 Tablets.**—Analysis showed Tartar Emetic 16.7, Calcium Sulphate 61.4, Talc 3.1 per cent. with Starch and colouring matter. A trace of a pungent substance resembling pepper, and a trace of vegetable debris which may have been from some vegetable extract—were also present. Each Tablet would contain 0.48 grain Tartar Emetic.—*B.M.J. i./12,143.*

* **Allen's Antifat.**—70 minims liquid extract of Fucus in the ounce.—*B.M.J. ii./07,209.*

* **Antexema.**—Soft Paraffin 35.4, Boric Acid 1.5, Gummy Matter 12.4, Water 50.7.—*B.M.J. i./08,942.*

Antidipso.—(Drink cure) Chlorate of Potash and Sugar.—*L. ii./03,1493.*
White Powders.—Potass. Brom. 24.5, Milk Sugar 75.5%. Coloured Powder.—Potass. Brom. 35, Milk Sugar 65%.—*B.M.J. i./09,910.*

Anti-fat.—See Allen's above.

* **Antineurasthin.**—Tablets would contain approximately Dry Yolk of Egg 3.8, Dry White of Egg 5.4, Dry Separated Milk 57.8, Gum 2.0, Potato Starch 22.7, Moisture 8.3%, Aromatic substances traces.—*B.M.J. i./09,544; see also P.J. i./08,644.*

* **Antipon.**—(Obesity).—Contains 39 grains per ounce of Citric Acid.—*B.M.J. ii./07,25.*

Anturic Bath Salts.—Analysis showed the salt to consist of Sodium Carbonate (reckoned as Anhydrous) 96.86%, Water 2.70%, Chloride, Potassium salt, perfume traces.—*B.M.J. i./10,393.*

Armbricht's Coca Wine—Alcohol 15.05, Glucose 20.8, Coca Alkaloids, 0.006%, *inter alia*. Wineglassful represents about 14 minims of Liquid Extract of Coca.—*B.M.J. i./09,1307.*

Atkinson & Barker's Royal Infants' Preservative.—

Analysis showed in 100 by measure.—Potassium Bicarbonate 1.75, Magnesium Carbonate 5.45, Essential Oil about 0.06, Alcohol 7.0 by measure, Sugar 9.9, colouring matter a trace.—*B.M.J. i./12,683.*

* **Balsam of Aniseed.**—See Powell's.

Baring Gould's Antirheumatic Pearls.—Gelatine Pearles or Capsules containing white powder analysis of which showed Acetyl-Salicylic Acid 85%. Milk Sugar 15%.—*B.M.J. ii./08,1112.*

***Beecham's Pills.**—(*Aperient*) Aloes, Ginger and Soap.—*L. ii.*/03,1493. Quantities as follows were found:—Aloes 0.5 grain, Powdered Ginger 0.55 grain. Powdered Soap 0.18 grain in a pill.—*B.M.J. i.*/09,32.

Formula in *S.R.* is stated to be incorrect,—several important ingredients omitted.—A large proportion of the ingredients come from foreign countries. A little over £100,000 was spent in advertising during 1912.—Sir Joseph Beecham, Evidence before Proprietary Medicine Enquiry—*P.J. i.*/13,102, see also Umney, *C.D. ii.*/12,723; *C.D. i.*/13,563.

Sir J. Beecham admitted having altered his formula.—*E. F. Harrison, C.D. i.*/13,650.

Beecham's Cough Pills.—In spite of the statement that these do not contain Opium, results obtained pointed to the formula: Morphine 0.0035 grain, Powdered Squill 0.1 grain, Powdered Aniseed 0.3 grain, Ammoniacum 0.3 grain, Extract of Liquorice 0.4 grain.—*B.M.J. ii.*/08,1699. The composition has been altered from time to time. Originally they contained some Morphine, then to comply with the Pharmacy Act this was removed,—now it has been replaced in trivial amount and the pills need not be labelled "Poison."—Sir Joseph Beecham, *P.M.C.E., P.J. i.*/13,102.

Bell's*Fairy Cure.—Powders each containing Acetanilide and Phenacetin each 1.16 grains, Caffeine 0.38 grain.—*B.M.J. ii.*/06,28.

Bendle's Meat Port Nutrient, White Cap Brand.

This preparation contains somatose equivalent to 1.4% Protein which represents 7% of raw meat and is a digestive product available for immediate nutrition. A wineglassful (2 ounces) is stated to contain 3.25 drachms of Alcohol.—*B.M.J. i.*/09,796, 867 and 964.

This preparation formed the subject of an action in the Courts, Bendle v. United Kingdom Alliance, in which Mr. Justice Bray gave judgment for the manufacturers.—"*Times*," July 14th, 1914.

***Bengue's Balsam.**—Analysis showed the composition to be:—

Menthol 18, Methyl Salicylate 20, Lanolin Anhydrous 54 and a fat, apparently Lard, 8%.—*B.M.J. ii.*/10,986.

***Bile Beans, Charles Forde's.**—Average weight 2.3 grains. Examination showed Aloin, powdered Cardamoms, Oil of Peppermint, Wheat Flour and possibly presence of Colocynth.—*B.M.J. i.*/11,1326.

***Birley's Anticatarrh.**—Analysis showed presence of: Sugar 74, Tartaric Acid 1.15, Phosphoric Acid 0.07, Alcohol trace, Water to 100. No free phosphorus could be detected, but odor suggested a trace.—*B.M.J. ii.*/08,1286.

Blair's Gout Pills.—Active ingredient is Colchicum.—*L. ii.*/03,1493. Quantities found indicated Powdered Colchicum Corm. 2.1 grain, Burnt Alum, 0.35 grain in one pill.—*B.M.J. ii.*/08,1110. (P) According to this Analysis.

Blanchard's Apiol and Steel Pills.—Freed from coating the pills had an average weight of 1.9 grains. Analysis showed presence of Sulphate of Iron, Soap, Barbadoes Aloes, Powdered Ginger, Cardamom, and Cinnamon, also a little Apiol.—*B.M.J. ii.*/11,36.

***Bovril Wine.**—According to analysis a wineglassful (2 ounces) would contain Alcohol 3½ drachms, Meat Extract 4.4 grains, Glucose 88.0 grains.—*B.M.J. i.*/09,795.

(P) **Bow's Liniment. Syn. Anodyne Liniment.** Dr. Bow's formula: Hard Soap 4, Opium 8, Ammoniated Camphor Liniment 60, macerate and filter. Dr. Bow's modified formula is Ammoniated Camphor Liniment 6, Belladonna Liniment 1, Soap Liniment 6, Strong Ammonia 1, Tincture of Opium 6, Mix, stand 7 days, and filter. These and other formulæ are given.—*P.J.F., 1907.*

***Box's Pills (see also Golden Fire).**—Average weight 2½ grains. The following formula gave a pill substantially agreeing in character with the pill under examination.—Powdered Capsicum 35, Powdered Gentian 15, Flour 15, Aloes 20, Soap 5, Water to 100 parts.—*B.M.J. ii.*/10,987.

(P) ***Bromidia.**—(Neuralgia), Potassium Bromide, Chloral, Hyoscyamus, Cannabis Indica, Aniseed Oil, Syrup and Water.—*L. ii.*/03,1493.

(P) ***Brompton Consumption and Cough Specific.**—The formula is approximately Liquid Extract of Ipecacuanha 0.75, Tincture of Opium 1.3, Treacle 75, Water to 100.—*B.M.J. ii.*/08,506.

***Brown's Bronchial Troches.**—Chemical analysis and microscopical examination showed the presence of Powdered Cubebs (also possibly Extract) about 6%, Extract of Liquorice in small quantity, Gum and Sugar (about 70%).—*B.M.J. ii.*/11,1543.

***Bunter's Nervine.**—Creosote, Chloroform, Camphor, Balsam of Tolu and Alcohol.—*L. ii./03,1493.*

Burgeaud's Wine.—Alcohol 14·80%, Glucose 18·9%, Alkaloids (Cinchona) 0·01%. A wineglassful represents about 2 minims of Liquid Extract of Cinchona.—*B.M.J. i./09,1308.*

***Burgess' Lion Ointment.**—The following is similar—Lead Plaster 13, Beeswax 20, Resin 11, Olive Oil 12, Water 6, Lard to 100.—*B.M.J. ii./07,393.*

***Burgess' Lion Pills.**—Average weight $4\frac{1}{2}$ grains without coating, Examination indicated Ipecacuanha, Rhubarb, a little Jalap, probably Aloes (Socotrine), Oil of Peppermint and Soap.—*B.M.J. i./11,1327.*

***Bynin Emulsion of Cod Liver Oil with Hypophosphites.**—Oil 34·6%, Reducing Sugars (as Maltose) 9·0%, Protein 1·2%, Hypophosphite in very small quantity.—*B.M.J. i./10,30*

***Bynol.**—Oil 12·9%, Reducing Sugar (as Maltose) 52·2%, Protein 4·6%, Diastatic Power 22.—*B.M.J. i./10,30.*

***Cadum.**—Analysis showed Zinc Oxide 11·3, Flowers of Sulphur 8·0, Boric Acid 3·1, Salicylic Acid 0·8, Oil of Cade 7, Hard Paraffin 10, Soft Paraffin 60%.—*B.M.J. ii./10,1352.*

***California Syrup of Figs.**—Senna (active constituent), Syrup of Figs and Cinnamon.—*L. ii./03,1493.*

***Capsuloids.**—Result of analysis indicated for the contents of the Capsules—Hæmoglobin 1·97 grains, Olive Oil and Oleic Acid of each 0·54 grains, Balsam of Peru and Purified Storax 0·17 grain in one Capsule.—*B.M.J. i./08,833.*

Carnrick's Liquid Peptonoids.—100 parts contained Alcohol 20, Total Solids 18·8, Nitrogen 0·8 (equivalent to Protein 5·0), Ash 0·8, Reducing Sugar calculated as Glucose 7·7, Cane Sugar 2·4.—*B.M.J. ii./09,562.*

(Requires spirit licence, but objection is not raised to its sale in small quantities by chemists when ordered by a medical man), c.f. also Vol. I. p. 633.

***Carter's Little Liver Pills.**

B.M.J. i./11,1326 states—Freed from coating average weight of the pill is $\frac{1}{2}$ grain, evidence of Aloes (Barbadoes) or a preparation of, Podophyllin, Powdered Liquorice Root and Wheat Starch was obtained.

Cassell's (Dr.) Blood Cleansing Tablets.—Weight about 6 grains each. Analysis showed Phenolphthalein 0·75, Pot. Iodide 1·25, Sugar 81, Talc approx. 11, Calcium Carbonate and Sulphate approx. 2, Water 1, Extractive 3%. The dose of Phenolphthalein in one Tablet is 0·045 grain, and the dose of Potassium Iodide is 0·075 grain.—*B.M.J. ii./10,1352.*

Cassell's Dusting Powder.—'Antiseptic Dusting Powder No. 2.' Analysis showed Powdered Talc 60, Boric Acid 20, Maize Starch 17, Slippery Elm Bark 3%.—*B.M.J. ii./10,1352.*

Cassell's Ointment.—'Ointment No. 2' showed as closely as possible,—Boric Acid 8, Borax 2, Oil of Eucalyptus 2, Oil of Wintergreen 3, Anhydrous Lanolin 4, Oil (? Olive) 8, Soft Paraffin 63, Powdered Drug (? Krameria root) 7, Water 3%.—*B.M.J. ii./10,1352.*

***C.B.Q. Post's Tablets** we understand are exempt from Poisons' Schedule, 1908. Analysis made in 1908 showed that each tablet contained $1\frac{1}{2}$ grains of Potassium Iodide, a small quantity of Salicylate, a vegetable Extract and Magnesia, also a small quantity of Alkaloid which was not identified.—'Secret Remedies.'

¶1 ***C.B.Q. Liniment No. 1.** (No. 2 not poison).

***Celmo No. 1.**—The proportions of the various constituents were determined as accurately as practicable, and indicated the following formula—Acetyl-Salicylic Acid 35·5, Powdered Charcoal about 8·0, Malt Extract, dry 18·0, Magnesium Silicate 14·5, other Mineral Constituents 2·8, Water 12·3, Alkaloid 0·5, Extractive about 8·0%. Oleo-resin of Capsicum a trace, Oil of Juniper, a trace.—*B.M.J. ii./10,986.*

***Celmo No. 2.**—An analysis showed these Tablets to contain Pepsin, about 3 grains in each Tablet together with Diastase (probably in the form of Malt Extract) and Socotrine Aloes. No evidence was found of any other ingredient.—*B.M.J. i./12,438.*

Chameleon Oil.—A mixture prepared by the following formula agreed in physical and chemical properties with the original, except in regard to some minor characters of the Resins. Essential Oils of Mustard 0·75, Spearmint 0·45, Pimento 1·5, Cassia 1·5, and Camphor 13·0, Oil of Turpentine 15·0, Alcohol (90%) 7·3, Strong Solution of Ammonia 8·0, Resins 1·6, and Water to 100. All in parts by measure.—*B.M.J. ii./10,983.*

Ⓟ ***Chlorodyne, Dr. J. Collis Browne's.**—(Coughs, etc.) Chloroform, Ether, Morphine, Cannabis Indica, Capsicum, Peppermint and Treacle.—*L. ii.*/03,1493; *ii.*/06,1390. Does not now contain Hydrocyanic Acid. Paul found practically 2 grains actual Morphine in 1 ounce.—*Pharm. Form.*

Cicfa.—See "Mother's Advice."

***Clarke's Blood Mixture.**—Potassium Iodide 52·5 grains, Spirit of Sal Volatile 10 minims, Spirit of Chloroform 67 minims, Simple Syrup 50 minims, Burnt Sugar q.s., Water to 8 ounces.—*L. ii.*/03,1493. *B.M.J.* *ii.*/07, 530. Contains no Sal Volatile but an entirely different preparation of Ammonia.—*E. J. Parry, P.M.C.E., C.D. i.*/13,562, *E. F. Harrison's reply, C.D. i.*/13,651.

***Cockle's (James) Pills.**—Average weight 4 grains. Analysis indicated presence of Aloes, a little Soap, Powdered Colocynth, Powdered Jalap, and another vegetable tissue which did not agree in character with any drug now in ordinary use and which could not be identified.—*B.M.J. i.*/11,1327.

Colman (The) Method. (For Catarrhs and Cold in the head).

The Nebular Tablets.—Average weight of a Tablet 20 grains. Analysis showed them to consist of Sodium Chloride 28·3, Borax (slightly dehydrated equivalent to crystalline Borax) 28·7, Sodium Bicarbonate 29·5, Sugar 12·3, Talc 3·1%, Oil of Wintergreen a trace. *The Atomising Liquid* was shown to consist of Liquid Paraffin with small quantities of Menthol and Oil of Cinnamon,—traces of other Essential Oils might be present.

The Gargle Tablets, average weight of a Tablet 20 grains. Analysis showed them to contain Borax (equivalent to crystalline Borax (4·6, Sodium Bicarbonate 87·0, Sugar 4·0, Talc 2·1, powdered vegetable drug (possibly Hydrastis rhizome) 1·5%, Turpentine a trace.

The Pills.—Average weight $\frac{2}{3}$ grain. Contain Aloin and indications of presence of Jalap Resin and Podophyllin.—*B.M.J. ii.*/11,1545.

***Coleman's Wincarnis.**—Wineglassful (2 ounces) would contain Alcohol 3 drachms, 8 minims. Meat Extract 10·5 grains, Glucose 159 grains.—*B.M.J. i.*/09,795. See also *Manufacturers in answer to Dr. Mary Sturge.*—*B.M.J. i.*/13,724.

***Congreve's Elixir.**—(Cough Mixture).—*L. ii.*/03,1493.

Analysis of the Elixir showed 28·5% by volume of Alcohol together with resinous material similar to the resins of Benzoin, Storax, Tolu or Balsam of Peru, Sugar about 1%. Alkaloid under 0·001%.—*B.M.J. ii.*/08,505.

Carton round the bottle states 'no poison whatever' and this we have reason ourselves to believe.

Cotandin Compound.—Cascara, Hydrochloric Acid, Water.—*L. ii.*/08, 104.

***Coza Powders.**—Average weight $1\frac{1}{2}$ grains, 90% Sodium Bicarbonate 5% each Cinnamon and Cummin.—*B.M.J. i.*/09,909.

***Crosby's Balsamic Cough Elixir.**—Contains inter alia Invert Sugar 58%, Alcohol 10·6%, Acetic Acid 0·3%, see *B.M.J. (ref.) Sulphuric Acid* corresponding to 44 minims of the official dilute Sulphuric Acid in one ounce.—*B.M.J. ii.*/08,1699.

Curic Wafers.—Acetanilide 3·28 grains, Phenacetin 3·28 grains, Caffeine Citrate 1·64 grains each.—*B.M.J. ii.*/06,27.

Curicones.—Analysis showed Sulphur, Lactose, Guaiacum Resin (about 10%), Acetyl-Salicylic Acid, Sodium Benzoate (about 25%), and a powdered vegetable drug resembling Cimicifuga Rhizome. Average weight of contents of one capsule is about $2\frac{1}{2}$ grains.—*B.M.J. i.*/15,992.

***Cuticura.**—Hard and Soft Paraffins, slightly perfumed with rose and coloured green.—*B.M.J. i.*/08,943.

***Cuticura Resolvent.**—Potassium Iodide, Sugar and Glucose, Extractive, Alcohol and Water.—*B.M.J. i.*/08,944.

***'Daisy' Powders** consist of Acetanilide alone, hence exempt from Medicine Stamp Duty. Each powder contains 5 grains.—*B.M.J. ii.*/06,27; *L. ii.*/06-1390; *C.D. i.*/13,529.

Dixon stated before the recent Proprietary Medicine Committee that Acetanilide is a dangerous drug, and that "lots of deaths" had been caused by headache powders containing it. J. Lawson representing "Daisy" however, pointed out that this is not supported by the Registrar General's returns for the last ten years, only one death being recorded as caused by headache powders (phenacetin), namely in 1908.

Statements have been made that there have been numerous deaths in America from use of Acetanilide. "Daisy" is not intended for Children.—C.D. i./13, 529; P.J. i./13, 472.

NOTE.—* "BUTTERCUP" is a trade mark of "Daisy, Ltd."

Details of the introduction of the Company's "Head Powder."—C.D. i./13, 529. These consist of Phenacetin alone. c.f., p 571.

Dalby's Carminative.—Rhubarb, Magnes. Carb., Glycerin, Sugar, Peppermint Oil, Dill Oil, and a small quantity of Laudanum.—L. ii./03, 1493. Proprietors say not a poison.

* **Damaroids.**—Freed from coating the Tablets had an average weight of 3.9 grains. The figures arrived at were Iron Hypophosphate 14.2, Quinine Sulphate 3.4, Extract (probably Damiana) 50, Sugar, Talc 16%.—B.M.J. i./11, 27.

Davis' Famous Female Pills.—Inter alia, Powdered Savin $1\frac{1}{2}$ grain in each with Sulphate of Iron.—B.M.J. ii./07, 1654. Proprietors say not a poison. A mixture made by them contains Gossypium.—ibid.

* "D.D.D." (For eczema). Analysis showed Salicylic Acid 0.75, Phenol 1.18, Methyl Salicylate (Oil of Wintergreen) 1.00, Glycerin 9.28, Alcohol 65.10, by measure, Water to 100 parts by measure.—B.M.J. ii./10, 1350.

* **De Roos' (Dr.) Compound Renal Pills.**—Freed from coating average weight of pills was 4.5 grains.—Contained Soap 34.2, Sodium Carbonate 19.7, a Resin (uncertain, probably Ammoniacum) 3.3, and a small quantity of vegetable tissue with moisture and extractive. Vegetable tissue could not be identified.—B.M.J. ii./11, 78.

Dearborn Ltd's. Preparations.—'Stalax' and 'Alakite of Orange' before the P.M.C.E.—P.J. i./13, 770; C.D. i./13, 831; B.C.D. i./13, 506.

Dixon's Pills.—(Aperient, Lixer) Taraxacum, Podophyllin, Jalap and Soap.—L. ii./03, 1493

* **Doan's (Backache Kidney) Pills.**—1. White-coated aperient Dinner Pills—Podophyllin, Aloin, Rhubarb and Peppermint 2. Brown-coated (Backache) Pills—Oil of Juniper and a resinous constituent (? Benzoin). L. ii./03, 1493. B.M.J. ii./06, 1646 gives as similar to the **Dinner Pills** a pill composed of Podophyllin, Aloin, Peppermint Oil, Jalap, Capsicum and Henbane Extract (this formulæ would of course be (P)): and for the Backache Pills, Juniper Oil, Hemlock, Pitch, Potassium Nitrate and Fœnugreek—in both instances with excipients in addition.—Parry has also reported on harmlessness of.

Doan's Dinner Pills.—There is at any rate one most important constituent omitted from above analysis.—Umney, P.M.C.F., C.D. ii./12, 721.

* **Doan's Ointment** (for piles) Calomel 36.6, Zinc Oxide 11.2, Phenol 1.3, Beeswax 2.3, Soft Paraffin 49.2%.—B.M.J. ii./08, 87.

* **Dodd's Kidney Pills.**—A Pill containing Cascarella, Jalap, Soap, Potassium Nitrate, Sodium Bicarbonate, Hard Paraffin, Turmeric and Wheat Flour is stated to be practically identical.—B.M.J. ii./06, 1646.

Dusart's Wine.—Alcohol 16.85, Glucose 12.8, Iron 0.09, Calcium 0.07. Phosphorus calculated as Phosphoric Acid 0.03%.—B.M.J. i./09, 1309.

* **Dycol.**—A mixture prepared in accordance with the following formula was practically undistinguishable from the original:—Essential Oils of Mustard 20, Nutmeg 20 and Allspice 4, Cottonseed Oil 6, Liquid Paraffin (yellow) 17, and Kerosene 33%—all by volume.—B.M.J. ii./10, 984.

(P) **Eade's Gout and Rheumatic Pills.**—The formula was found to be Barbadoes Aloes 10, Colchicum Extract 18, Colchicum Corm. powdered 35, Treacle 27, Gum and Dextrin 10%.—B.M.J. ii./10, 982. Must be labelled with word Poison and name and address of seller.

Eau de Blanc de Perles.—Contains inter alia about 15% Lead Carbonate.—Murrell.

(P) **Eau de Fleurs de Lys** contains a trace of Corrosive Sublimats.—Murrell.

* **Eczoline Ointment.**—Analysis showed Flowers of Sulphur 39, Zinc Oxide 3.7, Glycerin 13.5, Lard 39.8, Water 4%, Oil of Lemon a trace.—B.M.J. ii./10, 1351.

* **Eczoline Tablets.**—Analysis showed Ferrous Sulphate 16.5, Sulphur (precipitated) 56, Talc 3.4, Starch 7.3, Extractive 16.8 The Extractive appears to be a mixture of Cascara Sagrada and an inert Extract,—the former constituting about 5% of the substance of the Tablets.—B.M.J. ii./10, 1351.

* **Eno's Fruit Salt.**—(Aperient) Sodium Bicarbonate, Tartaric Acid and Citric Acid.—L. ii./03, 1493.

Epocol.—B.M.J. i./10, 762.

Fell Reducing Treatment.—Tablets would contain, according to analysis, Extract of Bladder Wrack 0.07 grain, Milk Sugar 0.91 grain (each Tablet had average weight 1 grain).—*B.M.J. ii./08,1568.*

Ⓟ ***Fellow's Compound Syrup (of) Hypophosphites** contains poison.—*L. ii./06,1390—vide also Vol. I., p. 639.*

***Fenning's Children's Cooling Powders.**—Average weight 3.4 grains. Analysis showed powder to consist of Potassium Chlorate 70, Powdered Liquorice 30%.—*B.M.J. ii./08,1022.*

***Fenning's Lung Healers.**—Average weight of one pill was 0.22 grains, chemical analysis and microscopical examination showed presence of Ipecacuanha only. Alkaloid present amounted to 1.8%.—*B.M.J. ii./11,1543.*

***Figuroids.**—The large tablets contained by analysis Sodium Bicarbonate 38.9, Tartaric Acid 13.1, Sodium Chloride 3.8, Phenolphthalein 1.2, Formamine (Hexamethylene Tetramine) 2.0 grains. The small Tablets 11.9, 15.9, 7.6, 0.5 grains respectively of the first four.—*B.M.J. ii./08,1567; i./09,556.*

Forde's (Chas.) Bile Beans, see **Bile Beans.**

Ⓟ **Freeman's Chlorodyne** contains less than 1% Morphine and does not contain Prussic Acid.—*By the Makers.*

***Fucol** is Sesame Oil containing a small quantity of Iodine. It is said to be made from Seaweed.—*B.M.J. i./07,879.*

Gautier's Female Pills.—Freed from coating the pills had an average weight of 3.8 grains. Analysis showed a small quantity of Aromatic Essential Oils (Pennyroyal, Rue and possibly Tansy) and probably Apioi. Principal constituents were Exsiccated Sulphate of Iron 10% and Soap 11%, Powdered Liquorice 30%, a little Powdered Ginger, and a small quantity of apparently Socotrine Aloes.—*B.M.J. ii./11,35.*

Ⓟ **Gelineau's Dragees** for Epilepsy are stated to contain Potassium Bromide, 1 in 1,000 Antimony Arsenate and 1 in 2,000 Picrotoxin. (Might be viewed as Ⓟ.)

***Genoform.**—Formula of the Tablets is Salicyl-Methylenc-Glycol-Ester 95, Starch and moisture 5%.—*B.M.J. ii./08,1113.*

Giant Remedy, The—see **Box's Pills and Golden Fire.**

Glendenning's Beef and Malt Wine.—Wineglass (2 ounces) contains Alcohol 3.33 drachms, Meat Extract 3.5 grains, Glucose 93 grains.—*B.M.J. i./09,796.*

***Gloria Tonic.**—(Gout and Rheumatism) Tablets. The following formula was indicated: Potassium Iodide 1.8, Guaiacum Resin 0.8, Ext. Liquorice 1.0, Resinoid (Phytolaccin?) 0.9, Powdered Liquorice 1.7, Rice Starch 2.0, Tale and Kaolin 2.1 grains. ***Gloria Pills.**—The following was indicated: Extract of Cascara 0.3, Ext. Soc. Aloes 0.5, Jalap Resin 0.07 grain, Flour and excipient q.s. in one pill.—*B.M.J. ii./08,1111; see also L. ii./03,1493.*

Glykaline.—(For coughs, colds, catarrhs, etc.) Analysis showed the liquid to contain 35% of Alcohol and 0.15% of solid matter consisting of Potassium Iodide and partly of organic matter. Each dose would contain $\frac{1}{816}$ grain of Potassium Iodide, with a trace of organic matter which may be derived from some drug.—*B.M.J. ii./11,1544.*

Goat Lymph Tablets contain Strychnine Phosphate, Zinc Sulphide. Ext. Muira Puama, Avenine and Cannabin.—*L. ii./08,104 (Presumably Ⓟ.)*

We understand these Tablets—one brand at any rate—are only supplied to the medical profession.

***Golden Fire.**—The following is the formula given by the analyst:—Oil of Amber 0.16, Oil of Rosemary 0.16, Oil of Eucalyptus 0.32, Oil of Camphor (essential) 1.3, Sodium Chloride 6.4, Glacial Acetic Acid 6.4, Alcohol 1.0 and traces of decoction of Capsicum, Barley and Lobelia.—*B.M.J. ii./10,987.*

***Gordon's Vital Sexualine Restorative,** see **Vital Sexualine.**

Guy's Tonic.—Phosphoric Acid, Tinct. Cochineal, Inf. Gentian and Chloroform Water.—*L. i./03,1493. B.M.J. i./11,26* gives the following formula as an exactly similar mixture.—Dilute Hydrochloric Acid 0.59, Dilute Phosphoric Acid 0.52, Alcohol 2.27, Compound infusion of Gentian 40, Chloroform Water 50, Cochineal q.s. Water to 100 parts by measure.

Hair's (Dr.) Cure for Asthma.—A fluid containing 5.6% Potassium Iodide, Tar Water and some Wine.—*L. ii./03,1493; B.M.J. i./07,879.*

***Hall's Wine** originally called **Hall's Coca Wine.**—Each bottle contains 1 grain of the extractive principle of Coca leaf and about 17% Alcohol. An overdose is likely to act as its own antidote by causing vomiting—a safeguard.

against taking excess. Not sufficient Coca present to induce Cocaine habit. For further details see *Manufacturer's evidence*.—P.M.C.E., C.D. ii./12,892; P.J. ii./12,751.

Hammond's Specifics.—See *Uricura*.

Hargreaves' Reducing Wafers.—*Fucus* and *Liquorice*.—B.M.J. ii./07,209.

Harvey's Blood Pills.—Contain among other ingredients about $\frac{1}{2}$ grain each Quinine Sulphate, about $\frac{3}{4}$ grain Potassium Iodide and about $\frac{1}{2}$ grain Rhu-barb.—B.M.J. ii./07,530.

Head Powders prepared by Daisy Ltd., consist of Phenacetin alone—8 grains in each.—J. Lawson, C.D. i./13,530. c.f. also p. 569. **Daisy Powders.**

Headache Powders usually contain Acetanilide, 3 grains each.

Healine (for rupture).—Analysis of Pills gave indefinite results.—c.f. B.M.J. ii./08,1198.

***Hoffman's Harmless Headache Powders.**—Analysis showed Acetanilide 5.02 grains, Cocoa 4.02 grains, Sodium Bicarbonate 1.01, as one powder.—*Secret Remedies*.

Hoffman's (Dr.) Rheumatic Powders:—

Analysis showed the following composition,—Acetyl-Salicylic Acid 66.4 Phenacetin 11.4, Caffeine 1.3, Sugar 20.1, Moisture 0.8%.—B.M.J. ii./10,982.

***Holloway's Ointment.**—Fresh Butter, Beeswax, Yellow Resin, Vinegar of Cantharides, Canada Balsam, Expressed Oil of Mace, Balsam of Peru or Liquid Storax.—Murrell.

We understand, however, from the makers that this contains nothing of a poisonous nature, and is not (P).

***Holloway's Pills.**—B.M.J. i./11,1326 states "The Pills had an average weight of 1.4 grains, examination showed the presence of Aloes (Barbadoes) or a preparation of Aloes, Powdered Ginger and Soap."

Holroyd's Gravel Pills.—Average weight of Pill freed from coating was 4.3 grains. From analysis the following formula was arrived at—Soap 40, Dried Sodium Carbonate 20, Powdered Rhubarb 20, Oil of Anise 10, Syrup 10.—B.M.J. ii./11,77

Hood's Sarsaparilla.—Dose $\frac{1}{2}$ to 2 teaspoonfuls. Analysis indicated 19% by volume of Alcohol and $7\frac{1}{2}$ grains of Potassium Iodide in the ounce, the amount of Sarsaparilla being small.—B.M.J. ii./07,531.

Hood's Vegetable Pills.—After removal of coating average weight was $\frac{1}{2}$ grain. Examination showed Aloes (Barbadoes) or a preparation of Aloes,—probably Aloin, Ginger, Capsicum, Colocynth, Soap and probably a little Jalap.—B.M.J. i./11,1327.

Hooper's, Dr. John, Female Pills.—Analysis showed Iron Sulphate, Aloes, Jalap, Canella, Senna and Oil of Pennyroyal.—B.M.J. ii./07,1653.

***Horton's Benedict Pills.**—Average weight 4 grains. Analysis showed Sulphate of Iron corresponding to 10% Exsiccated Sulphate, Socotrine Aloes, Powdered Ginger and a vegetable powder probably Gentian.—B.M.J. ii./11,36.

***Hughes' Blood Pills.**—Contain Aloes, Jalap, &c.—B.M.J. ii./07,532

Hyomei.—From analysis and examination it was concluded that Alcohol and Liquid Paraffin formed each about 10% of the whole, Eucalyptus Oil (and possibly other Oils) appears to form the remaining 80%,—a small proportion of a mixture containing Wood Tar and Creosote was also indicated.—B.M.J. ii./11,1544.

***Imperatine Treatment for Epilepsy,** see Dale's.

Indian Tincture.—Capsicum, Cannabis Indica, Ether and Methylated Spirit.—Murrell.

(P)**Injectio Brou.**—Zinc Sulphate, Sugar of Lead, Laudanum, Tinct. Catechu and Water.—Murrell. Pharm. Form. says:—Zinc Sulphate 15 grains, Lead Acetate 30 grains, Catechu Tincture 1 drachm, Tinct. Opii Crocat (q.v.) 1 drachm, Water to 6 ounces. is generally adopted in making imitations.

Invigoroids.—The formula arrived at was:—In one Tablet Ext. Nucis Vom. 0.028 grain, Zinc Phosphide 0.067 grain (calculated from Zinc present). Saccharated Carbonate of Iron 0.50 grain, Asafoetida 0.25 grain with some Sugar of Milk.—B.M.J. i./11,91. This may be (P).

***Irristum.**—A Syrup of Phosphate of Iron with Quinine.—B.M.J. ii./07,1658.

I.R.S. Compound Golden Tablets.—Contain Ferrous Sulphate and Sodium Carbonate.—B.M.J. ii./07,1658.

James' Fever Powder.—Antimonious Oxide 1, Calcium Phosphate 2.

***Jefferson Dodd's Corrective.**—Contains Dec. Aloes Conc. with Chloroform Water and Water. Pills are Iron and Aloes.—B.M.J. ii./07,1654.

***Johnson's (Mrs.) American Soothing Syrup.**—Analysis showed in 100 by measure Sodium Chloride 5.66, Hydrochloric acid (B.P.) 2.33 by measure Reducing Sugars, calculated as Glucose 66.6, extractive coloring matter etc. about 5.0. The reducing Sugars appeared to be present in the form of Honey, representing about 85 parts of this.—B.M.J. i./12,683.

The proprietors point out that the preparation does not contain Hydrochloric Acid ("Secret Remedies" and B.M.J. state as above), but a third of it is lemon juice. Discussion in the P.M.C.E., C.D. ii./12,23; see also Parry, C.D. i./13,563.

Juvenia.—'Liquid No. 1' Solution containing 2% Hydrogen Peroxide, $\frac{2}{3}$ strength of '10 volume.' 'Liquid No. 2,' Paraphenylene Diamine 0.9%, Solution of Ammonia 0.6%, and trace of fixed Alkali.—B.M.J. i./10,153.

***Kaputine (for Headache and Neuralgia).**—Contains Antifebrin 6.3 grains in each, with Sugar 0.21 grains, and coloured with Ferric Oxide 0.05 grain.—L. ii./03,1493; B.M.J. ii./06,28.

Kargon Compound contains Fluidextract of Buchu, Potassium Acetate, Methyl Salicylate and Sugar.—L. ii./08,104.

***Karox Compound.**—The contents of several bottles of this preparation were examined and were found to differ very considerably in composition. Magnesium Sulphate varied from 1.45 to 6.87%. Potassium Citrate from 4.76 to 6.55%, Sugars about 8%. The Alcohol in one specimen was 6%, Nitrous Ether was present and a trace of Nitrite, Vegetable Extractive was between 1 and 2% but showed no characters indicative of its source. Microscopical examination of the sediment showed the presence of yeast-like cells and the minute plants known as desmids.—B.M.J. ii./11,79.

Kasco Tubacyllus (Cassell & Co.'s).—Substantially a mixture of Citric Acid 0.19, Sulphurous Acid 1.06, Cane Sugar about 5.5, Water to 100.—Editor, B.M.J., and Analysts in 'Secret Remedies'—for 'Truth.'—B.M.J. ii./15,508.

(P)*Kay's Linseed Compound.

100 parts contained 1.07 parts of Chloroform, and 4.3 parts of Alcohol both by measure, 67 parts of Solids—about 48 parts of the latter sugar, and the remaining 19 parts consisted principally of the mucilage of decoction of linseed. Ipecacuanha alkaloids extracted amounted to 0.007%, and the Morphine to 0.021%.—B.M.J. ii./08,1698.

There is in the S.R. Analysis no mention of Senega which is one of the principal ingredients, while the analysis states that Ipecacuanha is present but there is no mention of it on the label.—Umney, P.M.C.E., C.D. ii./12,891.

***Kay's Tic Pills.**—Iron Sulphate. Quinine and Soap.—L. ii./03,1493.

(P)*Keating's Pectoral Lozenges.—Corresponded to Morphine 0.007 grain, Ipecacuanha 0.07 grain, Extract of Liquorice 2.1 grain, Sugar 13 grains in one lozenge.—B.M.J. ii./08,1699.

***Keene's "One Night" Cold Cure.**—Ingredients found were Cinchonidine Sulphate 0.21 grain, Acetanilide 0.32 grain, Calcium Carbonate 0.25 grain, Starch 0.34 grain, Extractive and excipient 0.87 grain (all figures approximately).—B.M.J. ii./08,1286.

***Kepler Solution of Cod Liver Oil in Malt Extract.**—Analysis showed Oil 17.4%, Reducible Sugar (as Maltose) 42.5, Protein 3.4, Diastatic Power 3.—B.M.J. i./10,30.

***Ker-nak Pills.**—Average weight without coating $1\frac{1}{2}$ grain. Examination indicated Aloes, a little Soap, a very little Oleo-resin of Capsicum, and a little vegetable tissue resembling Marshmallow root.—B.M.J. i./11,1327.

***Kilmer's (Dr.) Indian Cough Cure.**—Contains *inter alia* (see ref.) 0.5% Oil of Pumlilo Pine No alkaloid.—B.M.J. ii./08,1698.

Kola Wine, Christy's.—Alcohol 18.85, Glucose 8.6, Alkaloid (with characteristics of Caffeine) 0.03. Each fluid ounce represents $6\frac{1}{2}$ grains of Kola.—B.M.J. i./09,1307.

***Koko.**—Borax 1.4, Glycerin 1.7, Formaldehyde Solution (40%) 0.1, Perfume a trace, Alcohol 3, Water to 100 by volume.—B.M.J. i./10,151.

Lady Webster's Pills.—Aloes 2 grains, Powdered Mastiche $\frac{1}{2}$ grain, Red Rose Leaves $\frac{1}{2}$ grain with Syrup of Wormwood.—Murrell.

Lamplough's Pyretic Saline (Aperient).—Citric Acid, Potassium and Sodium Bicarbonates.—L. ii./03,1493.

Lane's (Dr.) Catarrh Cure.—Analysis showed Phenol 0.4, Sodium Chloride 3.3, Water to 100.—B.M.J. ii./08,1285.

(P) Laville's Gout Cure. Colchicine about 0.08% and Quinine in Alcoholic Solution.—*B.M.J.* ii./07,677.

The following is similar, (*Ph. Form.*)—Quinine 4 drachms, Colocynth Extract 2 drachms, Alcohol 90% 4 ounces, Malaga Wine 15 ounces. Mix and filter. Dose.— $\frac{1}{2}$ to 4 drachms in $\frac{1}{2}$ wineglass of water.

The Pills are (*Ph. Form.*) Extract of Winter Cherry 3 dr., Sodium Silicate 1 dr. Make a mass and divide into 5 grain Pills. Dose.—4 to 10 daily. Guaiacum Resin a constituent with the Silicate and Winter Cherry and other ingredients.—*Vide Secret Remedies.*

*** Lemco Meat Wine.**—A wineglassful (2 ounces) would contain Alcohol 2.75 drachms, Meat Extract 5.2 grains, Glucose 112 grains.—*B.M.J.* i./09,795.

Levasco.—A mixture prepared in accordance with the following formula was practically indistinguishable from the original:—Oleo-resin of Capsicum 3 grains, Camphor 6 grains, Oil of Lavender 3 minims, Oil of Rosemary 4 minims Soap $\frac{1}{2}$ grain and Methylated Spirit to 1 ounce.—*B.M.J.* ii./10,984.

*** Licoricine.**—Does not contain poison.—*L.* ii./06,1390.

Liebig's Meat and Malt Wine.—See Lemco.

Limosan.—*B.M.J.* i./10,762.

*** Liquifruta (A Consumption Cure).**—Analysis showed Oil Peppermint Onion or Garlic Oil and Alkaloids, of each traces, Potassium Bitartrate 0.4, Glucose 34.4, Cane Sugar 2.28, Mucilage, Tannin, Extractive, etc. and water to 100.—*B.M.J.* ii./09,1419.

Lockyer's Sulphur Hair Restorer.—Precipitated Sulphur 1.3%, Lead Acetate 1.6, Lead Sulphate 0.4%, Glycerin 9.6%, Rose Water to 100 by volume.—*B.M.J.* i./10,151.

Locock's Pulmonic Wafers.—Lactucarium, Ipecacuanha and Squills—Murrell. This form would make the preparation **(P)**.

*** McKenzie's (Dr.) "One Day" Cold Cure.**—Analysis showed the Tablets to have composition Cinchonidine Sulphate 0.83 grain, Acetanilide 0.71 grain, Camphor 0.1 grain, Talc 0.21 grain, Water 0.15 grain.—*B.M.J.* ii./08,1285.

Magic Foot Drafts.—Analysis of the plaster showed the formula to be approximately,—Powdered White Hellebore 40%, Stockholm Tar 60%.—*B.M.J.* ii./10,985.

Maltico.—Described as a perfect "infant food." Analysis showed Fat 3.9%, Reducing Sugars (as Maltose) 66.5%, Protein 16.8%, Ash 4.6%, Water 3.6%.—*B.M.J.* i./10,30.

Mariana Wine.—Alcohol 36.3, Total Solids 30.3, Ash 0.2, Reducing Sugar (as Glucose) 9.8, Cane Sugar 17.5, Alkaloids 0.025.—*B.M.J.* ii./09,562.

*** Marmola.**—Quantitative determination difficult

Formula arrived at was—Dried Thyroid Gland 1.4 grain, Phenolphthalein 0.4 grain, Sodium Chloride 0.7 grain, Powdered Fucus Vesiculosus 5 grains, Extractive 2.5 grains, Oil of Peppermint trace.—*B.M.J.* ii./08,1566. Another analysis, *L.* ii./08,104

Martin's Apiol and Steel Pills.— $1\frac{1}{2}$ grains of Aloes in each with, inter alia, reduced Iron and Apiol each $\frac{1}{10}$ grain.—*B.M.J.* ii./07,1655.

*** Martin's (Dr.) Miracletts.**—Results of analysis indicated Quinine Valerianate 0.4, Zinc Valerianate 0.1, Ferric Oxide 0.3, Menthol 0.03 grain, Kaolin and Talc 2.3 grains.—*B.M.J.* i./09,31.

Marza Wine contains Iron, Phosphorus, Coca and Pepsin. Discussion as to quantities.—*P.M.C.E.*, C.D. ii./12,892.

Mattei's Remedy.—For a reply arising out of the question whether a mixture of sugar and water could be successfully launched as a proprietary medicine, vide *P.M.C.E.*, C.D. ii./12,24.

Menstruation Powders.—Particulars are given of several consisting of Chamomile only.—*B.M.J.* i./10,1189.

*** Mer-Syren Powders.**—Indigestion and dyspepsia.

Average weight $25\frac{1}{2}$ grains. Microscopical examination showed the presence of potato starch. No other substance could be detected.—*B.M.J.* i./11,1325.

*** Mexican Hair Renewer.**—Precipitated Sulphur 1.4%, Lead Acetate 0.1 (one sample examined contained 0.97%), Glycerin 19.0%, Rose Water to 100 by volume.—*B.M.J.* i./10,512.

Migranol.—10% Solution of Menthol in Acetic Ether with 4% Spiritus Dzondii (*q.v.* in text) with Camphor and some sweet smelling Ethereal Oils.—*B.M.J.* i./07,879.

Miol.—Analysis showed it to contain Oil 22.4%, Reducing Sugars as Maltose 41.3%, Diastatic power 2.—*B.M.J.* i./10,30.

Morgan's (Dr.) Radio-Vimettes, *see* **Radio Vimettes**.

***Morison's Pills.**—(For Obesity). One contains Aloes, Jalap, Resin, Cream of Tartar, and probably Colocynth; the other some Gamboge as well.—*B.M.J.* i./07,832.

Mothersill's Seasick Remedy.—Contents of Capsules—a pink and a brown powder on analysis gave the following:—

Pink Powder.—Sugar of Milk 33.3, Caffeine 8.2, Stearic Acid 18.0, Chlorbutol 40.1%, colouring matter a trace.

Brown Powder.—Powdered Cinnamon 29.4, Caffeine 8.4, Stearic Acid 17.4, Chlorbutol 44.5%. Stearic Acid is probably added as a lubricant to assist in filling the capsules though the amount is large for the purpose.—*B.M.J.* ii./10, 1928.

***Mother's Advice.**—Recently *Tablenes* and formerly 'Cicfa' and before that 'Tablonas.' Contained Pepsin, Diastase and other ingredients.—*B.M.J.* i./09,556.

B.M.J. i./11,1325, gives the following:—Analysis showed presence of Pepsin corresponding to $\frac{3}{4}$ grain Pepsin B.P., diastase, reducing sugar (apparently Maltose), a bitter extract agreeing in characters with *Ext. Cascara Sagrada* about $\frac{1}{2}$ grain, a pungent substance which appeared to be Oleo-resin of Capsicum about $\frac{1}{100}$ grain, Talc and a little starch probably derived from the coating.

The starch is not converted by Diastase as inferred in *S.R.*—*E. J. Parry*, *P.M.C.E.*, *C.D.* i./13,563.

***Munyon's Blood Cure and Munyon's Kidney Cure.**—Granules, entirely Sugar (quantitative determination showed just 100%).—*B.M.J.* i./07, 213; ii./07,531.

***Munyon's Catarrh Tablets.**—Analysis showed Sodium Bicarbonate 1.87 grains, Sodium Chloride 1.81 grains, Borax, partly dehydrated 2.2 grains. Phenol traces. Gum 0.12 grain.—'Secret Remedies.'—*B.M.J.* ii./08,1286

***Munyon's Special Catarrh Cure.**—Determination showed these pills to consist of 100% sugar.—*B.M.J.* ii./08,1286.

***Munyon's Pile Ointment** consists of Soft Paraffin with trace of Ichthyol, probably less than 0.2%.—*B.M.J.* ii./08,87.

Murray's Fluid Magnesia was run by a medical man, physician to the Lord Lieutenant of Ireland, 1859. Advertised in the first number of "Chemist and Druggist."—*E. J. Parry*, *P.M.C.E.*, *C.D.* i./13,560; *B.M.J.* i./13,834.

Nelson-Lloyd Safe Reducing Treatment.—The Tablets contained *inter alia* (see ref.), Bladderwrack Extract and Thyroid gland proteid. Liquid similar.—*B.M.J.* ii./08,1568, or vide *Secret Remedies*.

***Nervelettes, Coleman's.**—Phosphorus 0.005 grain and Quinine Sulphate 0.07 grain with vegetable matter 0.3 grain were determined.—*B.M.J.* i./09,32.

[P] Neuraline.—Aconite with Chloroform and Rose Water.—*Murrell*.

Neurovril.—Analysis showed that 100 parts (by measure) contained 18.9 parts (by measure) of Alcohol and gave 19.1 parts of residue on evaporation, of which 18.1 parts consisted of Sugar. No appreciable amount of "serum" or other animal substance was present. If the "active principle" contains as stated on label 75% of Phosphate and 20% of albumen, it follows from the analysis that only a minute trace of it is present in the liquid which is practically a mixture of simple syrup and diluted alcohol.—*B.M.J.* i./12,26.

"Normal" Pills.—(For reducing obesity)

Each pill contained approx. *Ext. Cascara* $\frac{1}{4}$ grain, *Ext. Fucus vesiculosus* $\frac{1}{4}$ grain, *Liquorice Powder* $\frac{1}{4}$ grain, Talc and moisture $\frac{1}{4}$ grain.—*B.M.J.* i./11,825.

***Normyl** (T.M. 267639) **Treatment.**—The mixed liquid was found to contain alcohol 75.5% by volume, alkaloid (principally strychnine) 0.09%. A soft resin 1.5%. A non-alkaloidal bitter principle (possibly picrotoxin) a fair trace.—*B.M.J.* i./12,959. A delusion.—*M.P.*, July 28, 09, p. 99. See also *P.J.* ii./05,243,260. i./11,199.

A further examination (2nd Report by the B.M.A.) showed the "First" and "Second Treatment" to consist of bottles of reddish liquid of aromatic odour containing from 77 to 135 minims. The alcohol content ranged from 78.2 to 78.6% by volume. Alkaloid ranging from 0.062 to 0.076% consisted of Strychnine and Brucine, evidently derived from a preparation of *nuxvomica*. Endeavour was made to prove whether the non-alkaloidal bitter principle was Picrotoxin (c.f.) *B.M.J.* i./12,959, but it was found impossible to characterise it with certainty.—*B.M.J.* ii./12,981.

Success claimed in 92% of cases. It is unwise to sanction the sale of remedies at three guineas a treatment without the endorsement of the medical profession as to their efficacy.—M.P.C. i./14,376.

***Norton's Chamomile Pills.**—*Aloes, Gentian and Chamomile Oil.*—Murrell.

***Nurse Lilly's Female Pills.**—*Freed from coating, average weight was 1.9 grains. Contain Sulphate of Iron, 12%, Socotrine Aloes, Cinchonine Sulphate 3.3%, Powdered Capsicum about 30%, a little Powdered Ginger and Pennyroyal.*—B.M.J. ii./11,36.

***Orphine.**—*A preparation advertised by the St. George's Association as a cure for the Morphine habit. Analysis showed it to contain Morphine. First dose consisted of 0.374 grain and in course of a month a patient had taken 276 grains to cure him of the Morphine habit.*—C.D. i./12,926.

***Osogen.**—*Determination of the various ingredients gave the following formula: Quinine Glycerophosph. 0.75 parts, Iron Glycerophosphate 2.14 parts, Magnesium Glycerophosphate 0.77 parts, Sodium Glycerophosphate 0.9 parts. Spirit of Chloroform 3.8 parts by measure, Glycerin 73 parts by measure, Water 100 parts by measure.*—B.M.J. i./12,27.

***Ovaltine.**—*Described as 'composed of Malt Extract, Fresh Swiss Cow's Milk, Fresh Eggs, and converted Cocoa, and containing active Lecithin.' Analysis showed Fat 12.3%, Reducing Sugars (as Maltose) 60.0%, Nitrogenous substances calculated as Protein 13.4%, Ash 3.5%, Water 1.5%.*—B.M.J. i./10,30.

Glyn Jones' enquiries of Dr. Cox representing the B.M.A., regarding.—P.M.C.F., C.D. i./12,928.

***Owbridge's Lung Tonic.**—*Balsam of Tolu, Oil of Aniseed and Oil of Cloves.*—L. ii./03,1493. Does not contain poison.—L. ii./06,1390.

The alkaloids of Ipecacuanha were found to the amount of 0.002%. If present in the form of Wine of the official strength this represents Ipecacuanha Wine 15 m., Chloroform 2 m. in each ounce.—B.M.J. ii./08,1698.

***Oxien.**—*Powdered Sugar, Starch and Gaultheria Oil.*—L. ii./03,1493.

***Oxien Medi-Cone Pile Treatment.**—*The suppositories weigh on average 19 grains. Analysis showed Lead Acetate 5.6, Creosote about 2, Resinoid substance 3 (showing presence of Tannin), vegetable tissue 1, Hard Paraffin 7, Theobroma Oil 81.4%.*—B.M.J. ii./08,87.

Oxygar.—B.M.J. i./10,762.

***Ozerine (in epilepsy).**—*Potassium Bromide, Ammonium Iodide with Chloroform Water.*—L. ii./03,1493; B.M.J. ii./04,1586, gives approximately Potassium Bromide 120 grains, Ammonium Carbonate 16 grains per ounce (without Iodide), with Chloroform Water, &c.

***Ozonia.**—*Analysis showed the composition of the salt to be: Sodium Carbonate (reckoned as anhydrous) 77.00, Water 22.30, Chloride (reckoned as Sodium Chloride) 0.46%, Potassium Salt a trace.*—B.M.J. i./10,393.

***Paciderma Creme.**—*Zinc Oxide, Calcium Carbonate, Calcium Sulphate, Boric Acid and Basis.*—B.M.J. i./08,943. q.v. also for Powder and Blood Wafers.

***Page-Woodcock's Wind Pills.**—*Aloes, Caraway Oil and Soap.*—L. ii./03,1493; B.M.J. i./11,1326 gives the following:—*Freed from coating the pills had an average weight of 1.6 grains. Evidence of the presence of Aloes (Barbados) or a preparation of aloes, a little Ginger, a little Soap, a trace of Capsicum and Oils of Peppermint and Cinnamon, and some indistinguishable vegetable tissue.*

***Panopepton.**—*100 contained Alcohol 20, Total Solids 26.9, Nitrogen 1.14 (equivalent to Protein 7.2), Ash 1.1, Sugar 7.8.*—B.M.J. ii./09,562.

May be dispensed by registered chemists under certain conditions. Vol. I, p. 633.

***Parr's Life Pills.**—*Aloes, Rhubarb, Jalap, Gentian, Clove Oil.*—Murrell.

Peloids, see Stafford-Brookes'.

***Peps.**—B.M.J. ii./11,1543, summarises results of analysis (q.v. for further details), thus: Sugar about 70%, Extract of Liquorice about 25%, Resinous matter 0.7%, Oil of Peppermint a trace, Oil of Anise a trace, Talc about 4%.

***Perry-Davis' Pain Killer.**—*Spirit of Camphor, Tincture of Capsicum, Tincture of Murrah and Alcohol.*—Murrell.

***Phatolene Tablets.** *Analysis showed these ovoid pills of average weight 2.7 grains to consist of Ext. Fuci Vesiculosi with about 10% Powdered Liquorice root.*—B.M.J. i./11,824.

***Phelps Brown's Vervain Restorative.**—Decoction of Vervain (2 ozs. to a pint) 4 drachms, Port Wine 1 drachm, Alcohol 2 drachms, Water to 1 ounce. Dose.—2 drachms. Is 25% alcohol.—*B.M.J.* ii./04,1585. **Phelps Brown's Blood Purifier.** Nothing in particular found beyond 23% Alcohol.—*B.M.J.* ii./07,531.

Pink Pills.—Iron Sulphate, an alkaline carbonate, and Liquorice thickly coated with sugar and coloured with carmine.—*L.* ii./03,1493. See also Williams' Pink Pills.

Pinkham's (Mrs. Lydia E.) Vegetable Compound.—Analysis showed it to contain Alcohol 19.3% and Solid Matter 0.6%, traces of Tannin, Ammonia, and Reducing Sugar, also traces of a bitter substance soluble in Ether.—*B.M.J.* ii./11,33.

Plant's Cigarettes (For Asthma.)—Leaves of Stramonium, Lobelia, and Green Tea.—*L.* ii./03,1493.

Pond's Arthriticus.—Analysis of the liquid showed the mixture to have the following composition in one dose approximately: Lithium Citrate 5.0, Potassium Citrate 3.0, Sodium Citrate 0.7, Sodium Salicylate 5.3, Potassium Bromide 5.6, Potassium Bicarbonate 28.0, Glycerin 18.0 grains, in Dilute Chloroform Water. Analysis of the powder to be taken with the mixture showed an average of 14.2 grains of Tartaric Acid per dose.—*B.M.J.* ii./10,984.

Principal ingredient was formerly Potassium Acetate, but formula was altered by addition of Potassium Bromide and Salicylic Acid. Harrison again analysed and found analysis given in "More Secret Remedies" substantiated.—*C.D.* i./13,651.

***Poslam.**—Analysis showed approximately Zinc Oxide 12. Flowers of Sulphur 8, Maize Starch 18, Salicylic Acid 1.5, Oil of Cade (?) 1.5, Oil of Birch Tar 8, Anhydrous Lanoline 25.5, Soft Paraffin 25.5%.—*B.M.J.* ii./10,1353.

***Powell's Balsam of Aniseed.**—Used to contain Morphine but does not now.—*C.D.* i./13,650.

The Manufacturers inform us it contains no ingredient coming within **P** or **P** Parry detected an active ingredient not given in *S.R.*—*C.D.* i./13,565.

Pritchard's Teething and Fever Powders.—Dose on lines of Stedman's v. infra. Average weight 2.1 grains. Consist of Calomel 47, Antimony Oxide 0.7, Calcium Phosphate 1.4, Milk Sugar 50.9%.—*B.M.J.* ii./08,1022.

Quina Wine.—Alcohol 16.9%, Glucose 22.2%, Alkaloid Cinchona (0.05). "Two measures" represent about 10 to 15 minims Liquid Extract of Cinchona.—*B.M.J.* i./09,1308.

Radol Cancer Cure.—"An Acid Solution of Quinine."—*P.M.C.E.*, *C.D.* ii./12,605.

Radium Salve.—The α -radioactivity is about $\frac{1}{100}$ part of that of uranium. The β -radiation is too feeble to be detected by a sensitive electroscop.—*B.M.J.* i./09,1128.

***Red Cross Pills.**—Freed from coating the pills had an average weight of 2.6 grains. Analysis showed Resin 24.3, apparently Copaiba Resin, a small quantity of Oil of Copaiba, Magnesia 8%, Liquorice and Starch. No other active ingredients were found.—*B.M.J.* ii./11,78.

Rheumsol Bath Salts.—Analysis showed the Salt to consist of Sodium Carbonate (reckoned as anhydrous) 87.96%, Water 11.18%, chloride considerable trace, Potassium Salt trace.—*B.M.J.* i./10,393.

***Rice's Treatment for Rupture.**—An appliance and 'Lymphol.' Careful comparison indicated following for the 'Lymphol.' Tincture of Capsicum made with strong Alcohol 60, Oil of Origanum 6, Oil of Peppermint 1, Oil of Spearmint 0.3, Red Dye, q.s. Rectified Spirit to 100.—*B.M.J.* ii./08,1193.

***Roche's Embrocation.**—Olive Oil, Oil of Amber, Oil of Cloves, and Oil of Lemons.—Murrell.

Ruspini's Styptic.—A strong solution of Gallic Acid and Spirit of Roses, with perhaps a little Zinc Sulphate.—Murrell.

Russell's Anti-Corrupt Preparation.—Citric Acid (about 20 grs. to $\frac{1}{2}$ oz. a dose), with Water, and a little Iron. The Pink Tablet=Saccharin.—*L.* ii./03,1493; *B.M.J.* ii./07,25.

***Sacco, also called Lungsalva,** consists of Alcohol, glycerin, and a solid substance identical in its characteristics with *Krameria*.—*B.M.J.* ii./10,563.

***St. Raphael Tonic Wine—"Quinquina."**—Alcohol 16.89, Glucose 11.8, Alkaloid (Cinchona) 0.008. A wine-glassful=about $1\frac{1}{2}$ m. of Liquid Extract of Cinchona.—*B.M.J.* i./09,1308.

***St. Raphael Tannin Wine.**—Alcohol 14.65, Glucose 14.0, Tannin (as in ordinary Port Wine), Alkaloid a trace.—*B.M.J.* i./09,1309.

Sargol—‘*A Flesh Producer.*’ Analysis of the Tablets (average weight 5·3 grains) showed Zinc Phosphide 0·7, Lecithin 1·9, Calcium Hypophosphite 12·9, Sodium and Potassium Hypophosphites 7·7, Albumen (Soluble) 4·2, Insoluble Protein (? Coagulated Albumen) 10·8, Sugar 18%.—*B.M.J. i./12,846.*

The following formula is given :—*Ext. Saw Palmetto* 2 grains, *Calcium Hypophosphite* $\frac{1}{2}$ grain, *Sodium Hypophosphite* $\frac{1}{2}$ grain, *Potassium Hypophosphite* $\frac{1}{2}$ grain, *Lecithin* $\frac{1}{2}$ grain, *Ext. Nux Vomica* $\frac{1}{12}$ th grain.—*L. i./20,1275.*

* **Sarvar's Coca Wine.**—Alcohol 23·4%, Glycerin 6·1%, Glucose 2·6, Alkaloid (Coca) 0·07%. Dessertspoonful=about 21 minims of Liquid Extract of Coca.—*B.M.J. i./09,1307.*

Scott's Pills.—Average weight 2·4 grains. Examination indicated small quantity of Aloes, Ginger, Rhubarb and Soap.—*B.M.J. i./11,1326.*

Scott's Emulsion is stated to have the following composition: Cod-liver Oil 40 litres, Glycerin 19·875 kilos, Solution of Calcium Hypophosphite 0·8 per cent., 20·450 kilos, Solution of Sodium Hypophosphite 0·4 per cent., 20·150 kilos, Flavouring Essences 2·970 kilos, Gum 650 Gm.—*Ph. Notes.*

Seeger's Hair Dye.—*W. (Brown)* Pyrogallic Acid 3·8%, Cupric Chloride (anhydrous) 1·8%, Hydrochloric Acid (B.P.) 0·7%, Sulphuric Acid 0·07%.—*B.M.J. i./10,152.*

* **Seigel's (Mother) Syrup.**—

Quantitative determination indicated—

Dilute Hydrochloric Acid (B.P.) 10 parts by measure, Tincture of Capsicum 1·7 ditto, Aloes 2 parts, Treacle 60 parts, Water to 100 by measure —*B.M.J. i./09,33*

Correspondence between a doctor and the proprietors.—*B.M.J. i./11,572.*

Manufacturer said it contains 11 different vegetable extracts, not mentioned in above analysis, all possessing definite therapeutic qualities—the relationship of Aloes to the group of Extracts being as 25 to 181.—*P.M.C.E., P.J. ii./12,584 C.D. ii./12,723.*

Its value in dyspepsia and other affections discussed.—*C.D. ii./12,757,787, Umney's Analysis ibid. 789; see also B.M.J. ii./12,1482.*

There are vegetable extracts present not stated in *S.R.*—*E. J. Parry, P.M.C.E. C.D. i./13,563; E. F. Harrison's reply C.D. i./13,651.*

Serravallo's Tonic Bark and Iron Wine.—Alcohol 17·26%, Glucose 6·8, Cane Sugar 12·2, Iron 0·01, Alkaloid (Cinchona) 0·05, Liqueur glass represents about 3 minims of Liquid Extract of Cinchona.—*B.M.J. i./00,1308.*

Serum Bantier, “Anti-gonococcide” is not a serum, but a Solution of Magnesium-iodo-phenol Sulphonate.—*L. ii./08,104.*

* **Sequarine.**—The liquid contained Alcohol 35·8%, Oil of Peppermint a trace; on evaporation it left 1·9 per cent. solid residue of which 0·6 was ash,—principally Sodium and Potassium Phosphates. Nitrogen present 0·22 per cent.=to 1·4% of Protein, small portion present as Ammonia, perhaps formed by decomposition of nitrogenous organic matter. Definite constituents could not, of course, be isolated.—*B.M.J. i./11,27.*

* **Sexualine** *sec* **Vital Sexualine.**

Seymour, (Mrs.) Treatment.—Obesity. Contained Starch, an extract probably *Fucus vesiculosus*, Boric Acid and possibly a trace of thyroid.—*B.M.J. i./11,836.*

Shadeine (Brown).—Pyrogallic acid 2·1%, Cupric Chloride (anhydrous) 1·3%, Hydrochloric acid (B.P.) 0·3%.—*B.M.J. i./10,152.*

Singleton's Eye Ointment.—Analysis showed principal ingredient the Red Mercuric Oxide 7·4. Fatty basis contained *inter alia* about 4% beeswax.—*Secret Remedies.*

* **Standard Malt Extract and Cod Liver Oil.**—Stated to contain 25% Oil. Analysis showed Oil 4·1%, Reducing Sugar (as Maltose) 64%, Protein 5·9, Diastatic Power 74.—*B.M.J. i./10,30.*

* **Stearn's Headache Cure.**—Powders each contained Acetanilide 3·92 grains, Caffeine 0·98 grain, Milk Sugar 4·9 grains.—*B.M.J. ii./06,27.*

Stedman's Teething Powders.—Average weight 2·4 grains. For a child under 3 months the third of a powder; from 3 to 6 months $\frac{1}{2}$ a powder; when above 6 months a whole powder. The powder consists of Calomel 29% and Sugar of Milk 71%. A trace of alkaloids (not identified).—*B.M.J. ii./08,1022.*

* **Steedman's Soothing Powders.**—Calomel and Starch.—*L. ii./03,1493.* Average weight 2·8 grains each. Consisted of Calomel 27, Sugar 22, Maize Starch 50·5, Ash 0·5%. Directions similar to Stedman's above.—*B.M.J. ii./08,1022;*

Australian Customs require statement on the labels "The contents of this package include 27% Calomel" "Calomel has induced sleep." Opium is not present in any form.—P.M.C.E., C.D i./13,232: B.M.J. i./13,350.

Stevens' Consumption Cure.—According to B. M. A Analysis a preparation of *Krameria*.—B.M.J. ii./08,506. See also *ibid* i./09,672. and B.M. J. ii./12,1170,1242,1250,1341, ii./14,211,267.

***Sulpholine Lotion.**—Analysis showed Sulphur. precip., 3, Zinc Oxide 2.1, Calcium Sulphate 0.6, Glycerin 9, Strong Rose Water to 100 parts by measure.—B.M.J. ii./10,1352.

Tablones and Tablenes. See *Mother's Advice*.

Tatcho.—Borax 2.7%, Glycerin 2.5%, Quinine 0.006%, Formaldehyde Solution (40%) 0.38%, colouring and perfume a trace, Alcohol 2.4%, Water to 100, by volume.—B.M.J. i./10,151.

Taylor's Anti-Epileptic Medicine.—Formula ascertained was Tincture of Iodine $\frac{3}{4}$ m., Potassium Bromide 13 grains, Ammonium Bromide 4 grains, Water to 1 ounce. Dose.—1 teaspoonful thrice daily.—*Secret Remedies*

Terry's (Mrs.) Drink Cure.—Sugar 98% and Sodium Chloride 2%.—L. ii./03,1493.

***Therapion No. 3.**—Results indicated Camphor 2.5, Glycerin 24, Powdered Liquorice 40, Calcium Glycerophosphate 1.8, Extract of Gentian 5, Extract of *Damiana* (?) 8, Alkaloid 0.06, Water to 100.—B.M.J. i./09,32.

The Manufacturers inform us 'non-poisonous.'

Toris Root Compound.—Contains Sodium Salicylate, Potassium Nitrate and Sugar.—L. ii./08,104.

***Townsend's, Old Dr. Jacob, American Sarsaparilla** is similar to the B.P. '98 *Liquor Sarsæ Comp. Conc.* but without Liquorice and with addition of Sugar.—B.M.J. ii./07,530.

***Towle's Pennyroyal and Steel Pills.**—Contain about 14 grains Dried Iron Sulphate, Capsicum 86 grains, Pennyroyal Oil 3 minims, excipient q.s.,—in 100 pills.—B.M.J. ii./07,1653.

***Tremol Blood Mixture.**—A mixture prepared according to the following formula agrees very well in regard to the vegetable drug and perfectly in other respects. Calcium Chloride 224 grains, Solution of Ferric Chloride 300 minims. Dilute Hydrochloric Acid 200 minims, Concentrated Infusion of *Rhubarb* (1—7) 100 minims, Peppermint Water 2 ounces, Water to 8 ounces.—B.M.J. i./10,1064.

***Tremol Lotion.**—Analysis showed the liquid to consist of solution of chlorinated soda containing 2.9% of available chlorine.—B.M.J. i./10,1064.

***Tremol Ointment.**—Analysis showed the ointment to contain Prepared Chalk 70.3 parts, Soft Paraffin 29.0 parts, Yellowish brown colouring matter (? a coal-tar dye) traces.—B.M.J. i./10,1064.

***Tremol Ointment No. 2.**—The quantities of the different ingredients were determined, and the results agreed with the following formula: Zinc oxide 9.8, Lead Carbonate 3.5, Sodium Benzoate 0.3, Sodium Acetate 0.7, Water 9.6, colouring matter (Pink, evidently a coal-tar dye) traces, Lard to 100 parts.—B.M.J. i./10,1064.

Trench's Remedy for Epilepsy—Contains about 9 grs. Potassium and 1 grain Ammonium Bromide (concentrated form is 15 grains Potass. Brom. in a powder for a dose).—B.M.J. ii./04,1586.

Trommer's Elixir.—Stated to contain the active enzymes of Malt, Glycerophosphates, and what is described as the "alkaloidal" extractive of Cod livers.—L. i./10,653

Trommer's Malt Extract and Cod Liver Oil.—Oil 29.9%. Reducing Sugars(as Maltose) 41.4%, Protein 2.4%, Diastatic Power 35.—B.M.J. i./10,30.

***Trilene Tablets (For Obesity).**—Sugar and a vegetable constituent of unknown nature.—L. ii./03,1493. Minute quantity of *Fucus* amongst other ingredients, 87% Sugar.—B.M.J. ii./07209.

(11) *Tucker's Asthma Cure.—According to Dr. Wilcox, Home Office Analyst, in the action against the "Lancet," January, 1908, this contains Cocaine 2.28 grains, Atropine 0.87 grain, Sodium Nitrite 15.25 grs. per ounce. 20-30% Glycerin and a trace of Balsam or Benzoin.

A solution of Cocaine Nitrite 1.028, Atropine Nitrite 0.581 in Glycerin 32.16 and Water to 100 is said to produce good results when used in an atomizer. The Nitrites in question are not very stable salts

Another analysis says Atropine Sulphate 0.15, Sodium Nitrite 0.6, Glycerin 2.0, Water 15.00 —B.M.J. i./09,43

Vasey, for the "Lancet," found in one sample Cocaine 1.03 grains, Atropine 0.52 grains Sodium Nitrite 16 grains: in another. Cocaine 1.47 grains, Atropine 0.63 grains, Sodium Nitrite 24.46 grains.—C.D. i./08,112; B.C.D. i./08,73, c.f. also L. ii./03,1493.

The alkaloids in such a mixture may be determined by means of Platinic Chloride and estimating the Nitrogen in the precipitate,—then differentiating Cocaine from Atropine by precipitation with Potassium Dichromate Solution in strong Hydrochloric Acid.

Another method would be to soak up the fluid in a paste of Lead Oxide and Magnesium Oxide, extract repeatedly with Chloroform, filter, evaporate to dryness, weigh total Alkaloids, then titrate with N/100 Acid (using Phenolphthalein); this gives the amount of Atropine; finally titrate with Methyl Orange, which gives Cocaine.

Van Vleck's (Dr.) Absorptive Plasma.—Formula approximately: Powdered galls, 6 parts, Menthol 1 part, Crude Petroleum Jelly to 100 parts. **Ditto Food Cones** weigh 21 grains. Analysis showed wheat flour 28, Oil of Theobroma 63%, Water 4%, **Van Vleck's Pile Pills.**—Analysis showed small quantities of Powdered Capsicum, Powdered Licorice, and Maize Starch, and other ingredients. For further information, vide B.M.J. ii./08, 88,89.

Van Vleck's Catarrh Balm.—Analytical results gave formula: Phenol 0.6, Sandal Wood Oil 0.5, Oil of Pumlilio Pine 0.7, Eucalyptus Oil 1.2, Soft Paraffin to 100.—B.M.J. ii./08,1283.

★ **Vana.**—Alcohol 19.2, Glucose 20.0, Alkaloid (cinchona) 0.23, Calcium 0.01, Phosphorus (combined) as Phosphoric Acid 0.13. A wineglassful = about 3 minims of Cinchona Extract (Liq.).—B.M.J. i./09,1308

Varalettes (Bishop's Gout) showed presence of Lithium Citrate and a small quantity of what appeared to be Piperazine with the usual effervescing basis. —'Secret Remedies.'

Ⓟ **Var's, Dr., Kidney Pills** (Flexible Capsules) contain inter alia Peppermint Oil, Juniper Oil, Potass. Nit., Powdered Squill, Henbane and Taraxacum Extract.—B.M.J. ii./06,1646.

Veao's Lightning Cough Cure.—Analysis showed inter alia (vide ref.) 0.23% resin, resembling that of *Grindelia robusta*. It is alkaline, so is the Liquid Extract of *Grindelia* —B.M.J. ii./08,1699.

★ **Vibrona —a Wine of Cinchona.**—2 fluid ounces represent 5 grains of Cinchona Bark, the total alkaloids being in the form of Hydrobromides. A tonic preparation well adapted for use in cases of debility and nervous prostration.—B.M.J. The late B. H. Paul had the wine under systematic analytical supervision.

Vigoral.—Total Solids 50.8, Nitrogen 3.8 (equivalent to Protein 24.0), Ash 16.0%.—B.M.J. ii./09,563.

Vilixir.—(Liquid).—Sulphur precipitated 3.2%, Lead Acetate 1.8%, Glycerin 5.7%, Rosewater to 100 by volume. **Shampoo Powder;** Borax 4.6, Powdered Soap 24.4, Sodium Carbonate (partly exsiccated) 71.0%.—B.M.J. i./10,152.

Vincent's (Dr.) Anti-Stout Pills.—Evidence was obtained that they contained Jalap, Colocynth, Cloves, Aloes, or Extract of Aloes, Extract of *Fucus Vesiculosus*.—B.M.J. i./11,823.

Vin Regno (Pearson's Liebig's Beef Wine).—A wineglassful (2 ounces), contains alcohol 2.5 drachms, Meat Extract 2.6 grains, Glucose 65 grains Quinine not identified).—B.M.J. i./09,796.

Vin Urane Pesqui —Analysis showed inter alia in 100 parts by measure, Alcohol 8.75, Glycerin 3.55, total Solids 2.92, Uranium equivalent to Crystalline Nitrate 0.02 (= $\frac{1}{12}$ grain in fluid ounce, or $\frac{1}{2}$ grain in the daily dose).—B.M.J. ii./08,1875.

Vinsip (Liquor Hæmoglobin Co.)—Alcohol 8.6, Total Solids 20.2 Nitrogen 2.9 (=Protein 18.2) Ash 1.0 in 100 fluid.—B.M.J. ii./09,562.

★ **Virol.**—Analysis showed it to contain Fat 12.3%, Reducing Sugars (as Maltose, 59%), Diastatic power nil.—B.M.J. i./10,29.

★ **Vitæ-Ore.**—According to analysis each dose would contain Ferric Oxysulphate 0.47 grain and Magnesium Sulphate Anhydrous 0.15 grain.—B.M.J. i./11,27.

Wallace's Twelve Specific Remedies.—No. II. Analysis showed Berberine 0.05, Hydrastine 0.11, Alcohol 32.3 by volume, Extractive 2.7, Ash 0.3. No. III. Analysis showed Caffeine 0.25, Cane Sugar 1.7, Glucose 0.6. Ash 0.52, Alcohol 47.25 by volume, Extractive 3.13%. A Tincture of pale roasted coffee (1 to 5) appeared to be identical. No. V., Alcohol 30.5 by volume, Ash 0.2, Re-

ducing Sugars 2·9, Extractive 1·7. No. VII., Alcohol 51·05, Ash 0·22, Reducing Sugar 1·0, Fat and Extractive 2·1. A Tincture of Nutmeg (1 to 5) was found to agree in all respects. No. X., Alcohol 26·6, Ash 0·38, Reducing Sugars 0·55, Extractive 1·27. Very like weak Arnica Tincture. No. XI., Caffeine 0·11, Sugars (chiefly cane sugar) 0·7, Ash 0·26, Alcohol 51·05, Extractive 2·1. On same lines as No. III.—B.M.J. i./11,147.

Wallace's, Gordon, "Treatment."—Obesity. Freed from coating the Tablets had an average weight of 2·9 grains. Analysis showed them to consist of an extract agreeing with *Fucus Vesiculosus* Extract 2 grains and a vegetable powder, probably *Liquorice Powder*.—B.M.J. i./11,823.

*** Warner's Safe Cure.**—Potassium Nitrate (about 10 grains to the ounce) and various diuretic herbs.—L. ii./03,1493. A mixture made with Potassium Nitrate 50 grains, Alcohol 5 drachms, *Gaultheria Oil* $\frac{1}{2}$ minim, Liquid Extract of *Taraxacum* 10 drachms, Glycerin 4 drachms, and Water to 8 ounces is almost identical.—B.M.J. i./07,213. An Extract of Liverwort Leaves 30, Nitre 15, Glycerin 45, Alcohol 60, with some Wintergreen Oil. Pills.—Aloes, Soap, Marsh Mallow, and Liquorice.—B.M.J. ii./08,1377.

See also formula presented to German Government authorities by manufacturer.—M.P., Sept. 29/09,347.

Weidhaas Hygienic Institute.—See B.M.J. i./09,824.

*** Welch's Female Pills.** (*Kearsley's original Widow Welch's Female Pills*).—Contain Iron Sulphate, Sulphur, Liquorice, Turmeric with excipient.—B.M.J. ii./07,1654.

Whelpton's Purifying Pills.—Weight $2\frac{1}{2}$ grains. Chemical examination showed Aloes (apparently *Socotrine*), Powdered *Colocynth*, Ginger and Gentian. No evidence of Mercury or Calomel.—B.M.J. i./11,1326.

*** Williams' (Dr.) Pink Pills for Pale People.**—Contain Potassium Carbonate, Iron Sulphate and traces of Manganese Oxide and 'Neuræmin' (supposed to be a combination (?) of lecithin, hæmatin, and smilacin); the last is from *Sarsaparilla*; also a substance containing Emodin. Some Arsenic is contained in some.—B.M.J. i./07,879.

The quantities found indicated the following formula—exsiccated Sulphate of Iron 0·75 grain, Potassium Carbonate 0·66, Magnesia 0·09, Powdered Liquorice 1·4, Sugar 0·2, in one pill.—B.M.J. i./09,32. See also B.M.J. i./10,213.—Formula may have been altered.

Wilson's Patent Ringworm Cure. See 'Dethblo.'

Wincarnis, see *Colman's*.

*** Winslow's, Mrs., Soothing Syrup.**—Previously contained poison, but in November, 1909, was altered—does not come within provisions of Poisons and Pharmacy Act, 1908. c.f. C.D. i./13,650.

Analysis showed it to contain in 100 parts by measure, Potassium Bromide 2·0, Alcohol 4·3 parts by measure, Essential Oil (*Anise*) about 0·1 part. Sugar 56·0 parts, Emodin was present in small quantity, a Syrup containing 1·2% by measure of the Syrup of *Senna* (Off.), agreed in several respects.—B.M.J. i./12,683.

Woodcock's Pills, see *Page Woodcock's*.

(P) Woodcock's Cough Pills are stated to contain Morphine.

Woodbridge's Gout and Rheumatic Tincture caused death owing to having been taken in overdose; the ingredients contain *Colchicum*. The intestines were much inflamed.—W. W. Westcott's Coroner's Case.—P.J. i./13,17.

*** Woodward's Gripe Water.**—Analysis showed in 100 parts by measure Sodium Bicarbonate 1·08, Essential Oil about 0·03, Alcohol 3·8 parts by measure, Sugar 20·5. The Essential Oil appeared to be chiefly Oil of Caraway, with a little Oil of Dill, and possibly also of Anise.—B.M.J. i./12,683.

"The most important constituent is omitted in the S.R. analysis and those given are inaccurate."—Umney, P.M.C.E., P.J. ii./12,582; C.D. ii./12,721.

Government analyst, it was stated, failed to find an ingredient and he found certain ingredients that are not contained,—his report on analysis being:—

Alcohol 3·35, Sugar 18·87, Mineral constituents, chiefly sodium bicarbonate 0·92, Essential Oils 0·04, Capsicum Extract a trace, Water 76·82.

The figures are percentages by weight. The mineral constituents in addition to sodium bicarbonate included magnesium, calcium, and potassium, amounting to 0·08. These are probably adventitious, and due partly to the sugar and partly to the water. The quantity of essential oils is too small for chemical determination; but the constituents, judging chiefly by odour, consisted mainly of the oil of caraway and dill.

Umney's Evidence, P.M.C.E., C.D. ii./12,890 ; P.J. ii./12,750. Government Analyst communicated with replied 'No reason whatever to modify terms of report.'—C.D. i./13,221, see also E. J. Parry, ibid, p. 563.

Harrison admits trace of pungent aromatic substance.—B.M.J. i./13,947 ; C.D. i./13,651.

The Trade Mark under which this preparation is sold was the subject of legal proceedings. The rights in the mark by William Woodward, Ltd., were upheld.—P.J. i./15,315,337.

Zam-Buk.—*Eucalyptus Oil 14%, Pale Resin (Colophony) 20%, Soft Paraffin 55%, Hard Paraffin 11%, Green colouring matter, a trace.—B.M.J. i./08,944.*

***Zip Ointment**—*Calomel, Lead Acetate, Lead Oleate, Oil (probably Olive), Creosote, Oil of Lemon Grass, Paraffin Ointment.—B.M.J. i./08,944.*

***Zotos.**—*Capsules (sea sickness preventive), contained 6.3 grains, pinkish powder consisting of 76.9% Chlorbutol (Syn. Chloretone), and 23% Lactose.—B.M.J. ii./09,1419.*

***Zox Powders.**—*Average weight 4½ grains Consists of Acetanilide only —B.M.J. ii./08,1112.*

STAINS. TO REMOVE.

Stains.	On cloth. Removed with :—	On the skin. Removed with :—
Acid Picric .	.. Sodium Carbonate Solution, hot.	Sodium Benzoate Solution.
Acid Pyrogallie	.. First moisten with Ferrous Sulphate, and then wash in Oxalic Acid Solution.	Mix <i>with the fingers</i> Potassium Carbonate 1 oz., Calx Chlorinata $\frac{1}{2}$ oz., water 4 ozs. Or add 1 or 2 drachms of Strong Sulphuric Acid to $\frac{1}{2}$ pint of 25% Sodium Sulphite Solution, $\frac{1}{2}$ oz. of this diluted with 4 or 5 ozs. water.—P.J. i./20,616.
Acridiflavine ...	.. Dilute Hydrochloric Acid and finally bleach with a little Hypochlorite.	Sulphurous Acid, or dilute Sulphuric Acid and spirit.
Bromine ..	.. Liquor Sodæ (Caustic Soda Solution).	As for cloth.
Carbol Fuchsin	.. Sulphuric Acid and water. Repeat several times if necessary.	Sulphuric Acid and water.
Cascara (Liq. Ext.)	.. Ammonia	Soap and water.
Cochineal ..	.. Hot water	Soap and water.
Crocus (Saffron)	.. Wash with Hydrochloric Acid and boil with Washing Soda.	Washing Soda in water.
Eosin ..	.. Strong Hydrochloric Acid.	Strong Hydrochloric Acid.
Ferric Chloride	.. Oxalic Acid Solution ..	As for cloth.
Gentian Violet	.. Dilute Sulphuric Acid and Hypochlorite, as bleach afterwards.	Spirit.
Hæmatoxylon (Logwood).	Render acid and then use alkali, and bleach with Hypochlorite.	Make alkaline and wash with Dakin's Hypochlorite.
Henna ..	.. Hydrochloric Acid and hot water.	Use Hypochlorite.
Ink, black ..	.. Oxalic Acid, and finally bleach with Hypochlorite.	Soap and water.
Ink, red (if made with Eosin). (All best red ink is made with Eosin).	Hydrochloric Acid, and wash well.	Soap and water.

Stains, to Remove—contd.

Stains.	On cloth. Removed with:—	On the Skin. Removed with:—
Ink, typewriting (purple).	Dilute Hydrochloric Acid.	As for cloth.
Methylene Blue ..	Wash well with dilute Sulphuric Acid and use Hypochlorite after. Spirit also helps.	Spirit removes easily.
Potassium Chromate	Washes out with water	Soap and water.
Pot. Permang. ..	Sulphurous Acid ..	Sulphurous Acid.
Rhubarb ..	Hot soap and water. Bleach.	Soap and water.
Rosein Acetate	Wash with dilute Sulphuric Acid and use Hypochlorite after.	Spirit, strong.
Walnut Juice ..	Hot water and soap ..	Soap and water.

GLOSSARIES.

ARABIC GLOSSARY.

NOTE.—This was specially compiled for us by W. R. Robb while serving with H.M. Forces, from the language actually spoken in the Tigris valley and differs slightly from that spoken in Syria and Egypt. It might therefore be termed pure Mesopotamian.

Adalah, muscle.
Adwa, contagion.
Akab, heel.
Akrash, dumb.
Amaa, bowels.
Amee, blind.
Araj, lame.
Athm, bones.
Atrash, deaf.
Bahim, thumb.
Barham, ointment.
Burtup, lips.
Buttin, stomach.
Cashuggar, spoon.
Castakana, hospital.
Chab, ankle.
Chef, palm.
Chud, cheek.
Daboos, safety pin.
Dam, blood.
Dimagh, brain.
Dowa, medicine.
Dra, arm.
Eyein, eye.
Fachud, hip.
Firash, bed.
Gacha, cough.
Galub, heart.
Goosa, forehead.
Hab, pill or tablet.
Hajar asfar, jaundice.
Hajib, eyebrow.
Hakeem, doctor.
Halk, mouth.
Harg, burn.
Hasbah, measles.
Hasurtek, side.
Hawa asfar, cholera.
Henitch, chin.
Husbee, a sore.
Ichasm, nose.
Id, hand.
Ighma, faint.
Iridje, vein.
Irr, penis.
Ishal, diarrhoea.
Itches, elbow.
Ithin, ear.
Jidam, foot.
Jidiri, smallpox.
Jifn, eyelid.
Jild, skin.
Jimah, fist.

Jurra, wound.
Kanakina, quinine.
Kessr, fracture.
Kimawi, chemist.
Kitif, shoulder.
Koos, gonorrhœa.
Lesha, body.
Lissan, tongue.
Loca, wool.
Ma, water.
Madjrook, wounded.
Maljeedoo, arm sling.
Marad, illness.
Masmoom, poison.
Matishtugil, constipation.
Melatch, hydrophobia.
Mesdood, catarrh.
Middah, pus.
Misam, wrist.
Mitcheloo, jackal bite.
Nafas, breath.
Raad, bruise.
Rass, head.
Ridjla, leg.
Rimsh, eyelash.
Rookoboy, knee.
Rugba, neck.
Safra, bilious.
Saheyah, ambulance.
Schoona, fever.
Schtadt, bandage.
Shar, hair.
Sin, tooth.
Sudra, chest.
Susanak, syphilis.
Taon, plague.
Tenteryoke, application.
Thahr, back.
Uja, pain.
Urther, finger nail.
Usbah, finger.
Usbah ridjla, toe.
Waja rass, headache.
Warram, swelling.
Widja, face.
Yimina, right hand.
Yissira, left hand.
Yukos, cut.
Zayt, oil.
Zer doom, throat.
Zibb, testicles.
Zowwa, vomit.

BELGIAN GLOSSARY.

Belgian prescriptions are written in Latin or French (vide French Glossary) or a mixture of both languages. For a note on Belgian prescriptions by V. Renneboog, *see* C.D. i./15,362.

DANISH GLOSSARY.

- Aandedrag*, breathing.
Aare, vein.
Aare-Indsprøjtning, intravenous injection.
Atomspøjtje, spray or atomiser.
Badevand, lotion (lit. bath water)
Badning, fomentation.
Blære, blister.
Blandes, to be mixed.
Belægges (Piller), to be coated (pills).
Børstes, to be brushed.
Brækmiddel, emetic.
Citronsaft, lemon juice.
Daglig, daily.
Den smærtefulde Del, the painful part.
Dessertskefuld, dessertspoonful.
Draaber, drops.
Døgn, the space of 24 hours.
Efter Maaltid, after meals.
Etiket med Anvisning, label with formula.
Flaske, bottle.
Forkølse, cold
Forsølves (Piller) to be coated (pills)
Fortyndes, to be diluted.
For udvortes Brug, for external use.
Før Maaltid, before meals.
Gift, poison.
Glas Kapsler eller smaa Flasker, glass capsules or ampoules.
Glasstang, glass rod.
Gnidning, friction.
Gumme, the gums.
Gurglevand, gargle.
Haarvand, hair-lotion.
Hjærte, heart.
Hostemixtur, cough-mixture.
Hovedpine, head-ache.
Hud-Indsprøjtning, subcutaneous.
Hver anden, every two.
Hver tredje, every three.
Igle, leech.
Ikke, not.
I lige Dele, of each equal parts.
Indaanding-indaader, inhalation-inhaler.
Indgnid, rub.
Indgnides, to be rubbed.
Indgydes, to be instilled.
Indsprøjtjes, to be injected.
Indsprøjtning, injection.
I Vægt, by weight.
Klystér, enema.
Knuses eller brækkes, to be crushed or broken.
Kop, cup.
Krukke, pot.
Latverge, electuary.
Lige Dele, equal parts.
Ligtorn, corn.
Mælk, milk.
Mellem, between.
Moderkrans, pessary.
Mundvand, mouth-wash.
Muskel-Indsprøjtning, intramuscular injection.
Nat, night.
Næse, nose.
Næsebor, nostrils.
Omrystes, shake (the bottle).
Omslag, poultice.
Opblæsning, flatulence.
Opløse, dissolve.
Opsnuses gennem Næseborene, to be sniffed up the nostrils.
Pensle, paint (lit. pencil).
Pensles, to be painted.
Rystes, shake (the bottle).
Signatur, label (medical label!).
Skefuld, spoonful.
Smærte, pain.
Som foreskrevet, as directed.
Spiseskefuld, tablespoonful.
Spøjtje, syringe.
Stikpille, suppository.
Straks, at once.
Tages, to be taken.
Tandmiddel, dentifrice.
Teskefuld, teaspoonful.
To Gange, twice.
Tre Gange, three times.
Ved Sengetid, just before retiring to rest (lit. at bed-time).
Vekselvis, alternately.
Vægt, weight.
Øjendraaber, eye-drops.
Øjelaag, eye-lids.
Øjenhaar, eye-lashes.
Øjenskaerm, eye-shade
Øjenvand, eye-wash
Ørepine, ear-ache

DUTCH GLOSSARY.

Ademhaling, breathing.
Ader, vein.
Bed kken (pillen), to be coated (pills).
Besproeiingsstoestel, atomiser or spray.
Bestrijken, to be painted.
Blaar, blister.
Baarmoederkrans, pessary;
Braking, vomiting.
Citroensap, lemon juice.
Dagelijks, daily.
De flesch, bottle.
Dicht bij, near to.
Den volgende morgen, the next, or following morning.
Droppels or druppels, drops.
Etiket met recept, label with formula.
Gebruik, use, application.
Gedurende het bruisen, during effervescence.
Gegruisd of in stukjes gebroken, to be crushed or broken.
Gelijke deelen, equal parts.
Glazen capsules, glass capsules or ampoules.
Glazen staatje, glass rod.
Goedschudden, to be well shaken (the bottle).
Gorgelen, gargle.
Het pijnlijk deel, the painful part.
Het tandvleesch, the gums.
Hoest, de, the cough.
Inademing-respirateur, Inhalation-inhaler.
Indien het hoesten lastig is, when the cough is troublesome.
Indruppelen, to be instilled.
Inspuiting binnen de spieren, intramuscular injection.
Inspuiting binnen de aderen, intravenous injection.
Inspuiting onder de huid, subcutaneous injection.
Klisteerspuit, enema.
Kokend, boiling.
Kopje, cup.
Melk, milk.
Met mate, moderately.
Mondspoeling, mouth-wash.

Na den maaltijd, after meals.
Neertiggende (rustende), lying down.
Niet te gebruiken, not to be taken.
Om de beurt, alternately.
Om op te snuiven, to be sniffed up the nostrils.
Onmiddellijk, immediately.
Ooghaartjes, eye-lashes.
Oogkapje, eye-shade.
Oogleden, eye-lids.
Oogwassching, eye-wash.
Ook, also.
Op de gebruikelijke wijze, in the usual manner (as taken before).
Papmiddel, fomentation.
Per gewicht, by weight.
Plaatselijk aan te wenden, for local use only.
Potje, pot.
Prikkelend, irritable.
Purgeerend stroopje, electuary.
Spoeling voor de oogen, eye-wash.
Steekpilletje, suppository.
Sproeier, spray.
Spuit, syringe.
Stopsel van pluksel, tampon.
Tabletje, tablet.
Tandpoeder, dentifrice.
Van elk evenveel, of each equal parts.
Verdeeld in gelijke deelen, let it be divided into equal parts.
Vergift, poison.
Verzilveren (pillen), to be silvered (pills).
Volgens het voorschrift, as directed.
Voor het naar bed gaan, just before retiring to rest.
Voor inspuiting, to be injected.
Voor inwendig gebruik, for internal use.
Voor uitwendig gebruik, for external use.
Waskaars, bougie.
Winderigheid, flatulence.
Wrijven, rub.
Wrijving, friction.
Zonder, without.
Zoo noodig, if necessary.

FRENCH GLOSSARY.

A argenter pilules, to be silvered (pills).
A broyer ou concasser, to be crushed or broken.
A dragéfier (pilules), to be coated (pills).
A être instillé, to be instilled.
A moins que, unless.
Ampoule, blister.
Après les repas, after meals.
Au-dessus, above.
Au poids, by weight.

Avant les repas, before meals.
Baguette en verre, glass rod.
Bien, well.
Bien agiter le flacon, the bottle to be well shaken.
Boire, drink.
Bouillant, boiling.
C.à.c., à.d., à.s. = cuillerée à café, à dessert, à soupe, q.v.
Chaque jour, daily.
Charpie, lint.
Chauffé, warmed.

French Glossary—continued.*Cils*, eye-lashes.*Cœur (le)*, the heart.*Collyre*, eye-wash.*Comme il a été prescrit*, as directed.*Compte-gouttes*, a small glass tube to count drops.*Coton hydrophile*, absorbent wool.*Crépine et pulvérisateur*, spray and atomiser.*Cuillerée*, spoonful.*Cuillerée à café*, teaspoonful.*Cuillerée à dessert*, dessert-spoonful (10 gm.).*Cuillerée à soupe*, tablespoonful.*Cuillerée à thé*, teaspoonful (*ou à café*—5 gm.).*Cuillerée ordinaire*, tablespoonful (15 gm.).*Cuir*, leather.*De bonne heure demain*, early to-morrow.*De jour en jour*, from day to day.*De la façon habituelle*, in the usual manner.*De la façon prescrite*, in the manner directed.*Demain matin*, to-morrow morning.*Demain soir*, to-morrow night.*De temps en temps*, occasionally.*D'h en h. (D'heure en heure)*, every hour.*Dissoudre*, dissolve.*Douleur*, pain.*Dover Poudre*, Dover's Powder.*Droite (à)*, to the right.*Ds. (Dans)*, in.*Enème*, enema.*En se couchant*, lying down.*Ensemble*, together.*Entre*, between.*Etiquette*, slip-label.*Etiquette avec formule*, label with formula.*Flacon*, bottle.*Flacon (le) ayant été agité*, the bottle having been shaken.*Flatuosité*, flatulence.*Fomentation*, fomentation.*Garde-vue*, eye-shade.*Gargariser*, gargle.*Gencives (les)*, the gums.*Gouttes*, drops.*Hier*, yesterday.*Humburgum*, opium.*In caps. amyl*, in cachets.*Inhalation-inhalateur*, inhalation-inhaler.*Injecteur*, syringe.*Injection intramusculaire*, intramuscular injection.*Injection intraveineuse*, intravenous injection.*Jus de citron*, lemon juice.*Jusqu'à ce que*, up to.*Juste avant d'aller se coucher*, just before retiring to rest.*La hanche*, the hip.*Lait*, milk.*Main (la)*, the hand.*Le (or la) n'être*, the same.*Mechoachon*, Jalap.*Ne pas valoir*, not to be tallen.*Nuit*, night.*Par degrés*, by degrees.*Paupières*, eye-lids.*Pendant l'effervescence*, during effervescence.*Pendant que la douleur dure*, while the pain lasts.*Poignée*, handful.*Pour être appliqué avec la brosse*, to be brushed.*Pour être appliqué avec le pinceau*, to be painted.*Pour être aspiré par les narines en renflant*, to be sniffed up the nostrils.*Pour être injecté*, to be injected.*Pour l'usage partiel seulement*, for local use only.*Pour placer dans l'oeil*, to be placed in the eye.*Pour usage extérieur*, for external use.*Pr. (Pour)*, for.*Près de*, near to.*Quand la toux est gênante*, when the cough is troublesome.*Rince-bouche*, mouth wash.*Sangsue*, leech.*Sans*, without.*Saturne*, lead.*Semaine*, week.*Seul, e*, alone.*Si nécessaire*, if necessary.*Tasse*, cup.*Tous les deux jours*, every other day.*Tous les matins (soirs)*, every morning (night).*Tous les quarts d'heure*, every quarter hour.*Tous les trois jours*, every third day.*Toutes les deux heures*, every two hours, or every other hour.*Toux (la)*, the cough.*Un blanc d'oeuf*, white of an egg.*Une fois*, once.*Un jaune d'oeuf*, yolk of an egg.*Veine*, vein.*Verre à madère*, wineglass.*Verrée (une)*, wineglass (8 cuillerées ordinaires—20 gm.).*Versez*, pour off.

GERMAN GLOSSARY.

- Abend*, evening.
Abkochung, decoction.
Abwechselnd, alternately.
Ader, vein.
Alle-Stunden-Tropfen zu nehmen, so many drops every - hours.
Alle viertel Stunden, every quarter-hour.
Alle zwei Stunden, every other hour.
Allmählich, by degrees.
Anwenden, apply.
Atmen, breathing.
Auflösen, dissolve.
Augenlider, eye-lids.
Augenschirm, eye-shade.
Augenwasser, eye-wash.
Augenwimpern, eye-lashes.
Ausgenommen wenn, unless.
Ausgiessen, pour off.
Ausserlich anzuwenden, for external use.
Bahung, fomentation.
Becher, a cup.
Beim zu Bett gehen, at bedtime
Bis auf, up to.
Blahung, flatulence.
Blutegel, leech.
Brandblase, blister.
Bursten, to be brushed.
Charpie-Bausch, tampon.
Der schmerzende Teil, the painful part.
Dasselbe, the same.
Dessertloffel, dessertspoonful.
Diese Arznei darf nicht eingenommen werden, not to be taken.
Diese Arznei darf ohne erncute schriftliche Verordnung des Arztes nicht repetiert werden, this medicine may not be repeated without written order of the physician
Dragieren (pi'llen), to be coated (pills).
Drei mal taglich, thrice daily.
Durch die Nase einzuziehen, to be sniffed up the nostrils.
Ebenfalls, also.
Eigelb, yolk of an egg.
Eingeben, administer.
Einspritzung, injection.
Einspritzung in die Adern, intravenous injection.
Einspritzung in die Muskeln, intramuscular injection.
Einspritzung unter die Haut, subcutaneous injection.
Einzuspritzen, to be injected.
Einzutropfeln, to be instilled
Eiweiss, white of an egg.
Erbrechen, vomiting.
Erwärmen, to be warmed.
Essloffel, tablespoon.
Etikette mit Rezept, label with formula.
Flasche, bottle
Frottieren, friction.
Fur innerlichen Gebrauch, for internal use.
Gelegentlich, occasionally.
Genau, accurately.
Genugend, sufficiently.
Gestern, yesterday.
Gift, poison.
Glaskapsel oder Phiole, glass capsule or ampoule.
Glasstab, glass rod.
Gleiche Teile, equal parts
Gargelwasser, gargle.
Gut, well.
Herz, heart.
Hufte, hip.
Husten, cough.
In das Auge zu bringen, to be placed in the eye.
In der angegebenen Weise, in the manner directed.
In der gewohnten Weise, in the usual manner.
In gleiche Teile zu teilen, to be divided into equal parts.
Inhalations-Apparat, inhaler.
Jeden Abend, every evening.
Jeden Morgen, every morning.
Jeden zweiten Tag, every other day.
Klystier, enema.
Kochend, boiling.
Kurz vor dem Schlafengehen, just before retiring to rest.
Leder, leather.
Loffel, spoon.
Mazerieren, macerate.
Messerspitze voll, as much as lies on the point of a knife.
Morgen früh, to-morrow morning.
Mundwasser, mouth-wash.
Mutterzapfen, pessary.
Nach Anweisung, as directed.
Nach Bedarf, when required.
Nach dem Essen, after meals.
Nachdem man die Flasche umgeschüttelt hat, the bottle having been first shaken.
Nach einer Stunde, at the expiration of an hour.
Nach Gewicht, by weight.
Nahe, near.
Niederliegen, lying down.
Nur auf ärztliche Anweisung abzugeben, to be given only on the medical man's direction.
Nur fur ausserlichen Gebrauch, for external use only.
Nur fur ortlichen Gebrauch, for local use only.
Ohne, without.
Pinselfn, to be painted.
Recht, right.
Reiben, rub.
Reizbar, irritable.
Schmerz, pain.
Sofort, immediately.

German Glossary—continued.

So lange der Schmerz anhält, while the pain lasts.

Spritze, syringe.

Stets kuhl zu halten, to be kept cool.

Streichen, spread.

Stuhlzapfchen, suppository.

Stunde (Eine), one hour.

Tafelchen, tablet.

Taglich, daily.

Topf, pot.

Trunk, draught.

Ueber, above.

Uebersilbern (Pille), to be silvered (pill).

Umschütteln, to shake (the bottle).

Verbandwatte, absorbent wool.

Verordnen, prescribe.

Von Tag zu Tag, from day to day

Vor dem Gebrauch gut umzuschütteln, to be well shaken before use.

Vorsicht, with care.

Vorsichtig, cautiously.

Während des Aufbrausens, during effervescence.

Wenn der Husten belästigt, when the cough is troublesome.

Woche (Eine) one week.

Zahnfließch, the gums.

Zahnreinigungsmittel, dentifrice.

Zerreiben oder zerbrechen, to be crushed or broken.

Zerstäubungs-Apparat, spray or atomiser.

Zitronensaft, lemon juice.

Zubereitet, prepared.

Zu gleichen Teilen. of each equal parts

Zu nehmen, to take.

Zwischen, between.

ITALIAN GLOSSARY.

A caldo, warmed.

A essere aspirato dalle narici, to be sniffed up the nostrils.

A frantumarsi o spezzarsi, to be crushed or broken.

Aggiungere un cucchiaino ad un mezzo litro di acqua bollente, e fare inalazioni colla evaporazione, one teaspoonful to a "pint" of boiling water and the steam inhaled.

Agitare la bottiglia avanti l'uso, the bottle having been first shaken.

A gradi, by degrees.

Al di sopra, above.

A meno che, unless.

A peso, by weight.

Apparecchio respiratorio, respirator.

Applicare con un pennello, to be brushed.

Applicare la filaccia sulla ferita frequentemente, e appena asciutta ripetere di nuovo l'applicazione, Apply lint to the wound frequently, as soon as dry repeat the application again.

Bacchetta di vetro, glass rod

Bollire, boiling.

Bottiglia, bottle.

Candela, bougie.

Capsule o ampolle di vetro, glass capsules or ampoules.

Ciglia, eye-lashes.

Clistere, Enema.

Collirio, eye-wash.

Come fu detto, as directed.

Come fu detto avanti, as previously directed.

Cucchiiano da caffè, dessertspoon (very few people take "tea" in Italy.)

Cucchiaino, spoonful.

Cucchiaino da tavola, tablespoonful.

Cuoio, leather.

Da applicarsi dietro l'orecchio destro, apply behind the right ear.

Da applicarsi eggermente prima di coricarsi, to be applied lightly at bedtime.

Da applicarsi sulla eruzione cutanea, to be applied to the eczematous rash.

Da argentarsi (pillole), to be silvered (pills).

Da bere, drink.

Da instillarsi, to be instilled.

Da ricoprirsi (pillole), to be coated (pills).

Da sciogliersi, dissolve

Da somministrarsi, to be administered.

Da strofinarsi con un panno sul cuoio cappelluto sera e mattina, to be rubbed into the bare patch on the scalp night and morning.

Da usarsi localmente, for local use only.

Da vicino, near to.

Di giorno in giorno, from day to day.

Diviso in parti uguali, of each equal parts.

Dolore, pain.

Domani sera, to-morrow night.

Domattina, to-morrow morning.

Domattina presto, early to-morrow.

Dopo i pasti, after meals

Dopo un'ora, at the expiration of an hour.

Esattamente, accurately.

Etichetta, label.

Etichetta con formula, label with formula.

Falaccia, lint.

Filtrare, strain.

Fino a, up to

Italian Glossary —continued.

Fino a che dura il dolore, while the pain last
Fra mezzo, between.
Frizioni, friction.
Gurgarizzare, gurgle
Giacere, lying down.
Giornalmente, daily.
Giusto, right.
Gocce, drops (of liquid).
Idrofilo, absorbent.
Ieri, yesterday.
Il cuore, the heart.
Inaluzioni-inalatore, inhalation-inhaler.
Iniezione sottocutanea, subcutaneous injection.
Insieme, together.
L'anca, the hip.
La mano, the hand.
La tosse, the cough.
Latte, milk
Le gengive, the gums.
Lo stisso, the same.
Non piu di 4 volte al giorno, not more than four times a day.
Ogni due ore, *Un'ora si e l'altra no*, every other hour.
Ogni quarto d'ora, every quarter of an hour.
Ogni sera, every night.
Ogni due ore, every two hours.
Ogni tre giorni, every third day.
Palpebre, eye-lids.
Pastiglie, lozenges.
Pennellare la gola ogni giorno, una mezz'ora dopo calazione, paint the throat every day about half an hour after breakfast.
Per iniezioni to be injected.
Per pennellature, to be painted.
Per pennellature alle narici due volte al giorno, apply to the nostrils

with a camel's hair brush twice a day.
Per sciacquare la bocca, mouth-wash.
Prima di coricarsi, just before retiring to rest.
Pure, also.
Quando la tosse arreca disturbo, when the cough is troublesome.
Sera, night.
Se sara necessario, if necessary.
Settimanalmente, weekly.
Senza, without.
Siringa, syringe.
Sorso, draught.
Spruzzatore, spray.
Stoppaccio, tampon
Strofinare, rub.
Sugo di limone, lemon juice.
Tazza, cup.
Tre volte al giorno, three times a day.
Tutte le mattine, every morning.
Una goccia dentro la pupilla degli occhi una volta al giorno, a drop into the lower lid of each eye once a day.
Una manciata, handful.
Una settimana, a week.
Una volta, once.
Un bicchiere da vino, wine-glass.
Un bianco d'uovo, white of an egg.
Un giorno si ed un giorno no, every other day.
Un taelo d'uovo, yolk of an egg;
Un uovo, an egg.
Vaporizzatore, atomiser.
Vaso, pot.
Veleno, poison.
Vena, vein.
Versare, pour off
Vescica, blister.
Vicino, near.
Visiera, eye-shade.

PORTUGUESE GLOSSARY.

A, the (feminine).
Acima, above.
Algalia, bougie.
Almoco, breakfast.
Alternativamente, alternately.
Amanhã á noite, to-morrow night.
Amanhã pela manhã, to-morrow morning.
A menos que, unless.
A parte dorida, the painful part.
A pelle de craneo, couro (cabelludo), scalp.
A peso, by weight.
Applica-se suavemente na séle da dor, to be applied gently to the painful part.
Aquecido, warmed.
A serem cobertas (pilulas), to be coated (pills).

A serem prateadas (pilulas), to be silvered (pills).
A ser instillado, to be instilled.
A ser pincelado, to be brushed.
A ser pintado, to be painted.
As gengivas, the gums.
Atraz, behind.
Banho para o olho, eye-wash
Beber, to drink.
Bem, well.
Cabelludo, hairy
Calvo, bald
Capsulas ou ampoulas de vidro, glass capsules or ampoules.
Cautelosamente, cautiously.
Chiavena, Chicara, cup.
Clyster, enema.
Coar, to strain.
Colhér cheia, spoonful.

Portuguese Glossary—continued.

Colhêr de chá cheu, teaspoonful.
Colhêr de doce cheia, dessertspoonful.
Colhêr de sopa cheia, tablespoonful (soup-spoon).
Com cuidado, cautiously, with care.
Como indicado nas instrucções, as directed.
Com precisão, accurately.
Coração, of the heart.
Couro, leather.
Cuidadosamente, carefully.
De deitar-se, á hora, at bedtime.
De dia a dia, from day to day.
Depois, after.
De tres em 3 dias, every third day.
De vez em quando, occasionally.
Direito, lado, right side.
Dôr, pain.
Em partes eguaes, de cada, of each equal parts.
Emquanto durar a dôr, while pain lasts.
Entre, between.
Erupção, the rash.
Esfregar, to rub.
Estender, to stretch, extend.
Esterilisar, sterilise.
Etiqueta com formulario, label with formula.
Exactamente antes de retirar-se para descansar, just before retiring.
Fios de linho, or lichino, lint.
Flatulencia, flatulence.
Friccionar, rub.
Fricção, friction.
Fomentação, fomentation.
Garganta, the throat.
Gargarejo, gargle.
Garrafa, or Frasco, bottle.
Garrafa bem agitada, the bottle well shaken.
Gemma d'un ovo, yolk of egg.
Gotas, drops.
Hontem, yesterday.
Ho tia, cachet or wafer.
Inhalação - inhalador, inhalation-inhaler.
Injecção, injection.
Injecção intramuscular, intramuscular injection.
Injecção intravenosa, intravenous injection.
Injecção subcutanea (or epidermica), subcutaneous injection.
Irritavel, irritable.
Lavagem de boca, mouth-wash.
Lavagem para os olhos, eye-wash.

Leite, milk.
Mais, more.
Mão cheia, handful.
Mão, hand.
Mesmo, same.
Não, not.
Noite, night.
No meio de, in the middle of.
O, the (masculine).
Orelha, ear.
Pala para o olho, eye-shade.
Palpebras, eye-lids.
Panella, pot.
Para aspirar pela ventas, to be sniffed up the nostrils.
Para ser, to be.
Para ser injectado, to be injected.
Para ser triturado o quebrado, to be crushed or broken.
Para uso externo, for external use.
Pela manha, in the morning.
Pellica, kid leather.
Perto (de), junto (a), near (to).
Pestanas, eye-lashes.
Pó, powder.
Pulverizador, spray and atomiser.
Quadril, hip.
Refeições, meals.
Respiração, breathing.
Respirador, respirator.
Semana, uma, a week.
Seringa, syringe.
Sítio, place.
Sem, without.
Sim, yes.
Sumo de Limão, lemon juice.
Taça, large cup (goblet, bowl).
Tambem, also.
Tampon, tampon.
Todos os dias, daily.
Tosse, cough.
Uma gota na palpebra inferior, de cada olho, uma vez por dia, a drop into the lower lid of each eye once daily.
Uma hora sim, uma não, every other hour (one hour yes, one no).
Uma vez, once.
Um dia sim outre não, every other day.
Vareta de vidro, glass rod.
Vasar, to pour off.
Veia, vein.
Veneno, poison.
Ventá, nostril.
Vesicatorio, blister.
Vez, cada, each time.

SPANISH GLOSSARY.

Acepillarse, to be brushed.
Agua para lavar laboca, mouth-wash.
Agua para lavar los ojos, eye-wash.
A la hora de acostarse, at bed-time.
Almuerzo, breakfast (lunch).
Alternativamente, alternately.

Ampollus de vidrio, glass ampoules.
A no ser que, unless.
Aparato, de inspirar, inhaler.
Apliquese suavemente al sitio del dolor, apply gently to the painful parts.
Aspiración, breathing.

Spanish Glossary—continued.

Atrás, behind.
Beber, to drink.
Bien, well
Cabella (el) del cráneo, the hair of the scalp.
Cabritilla, kid leather.
Cadera, hip.
Calentado, warmed.
Calvo, bald.
Candelilla, bougie.
Cápsulas de vidrio, glass capsules.
Cerca, near, near to.
Colar, to strain.
Comidas, meals.
Con cuidado, with care.
Con precisión, accurately.
Corazón el, the heart.
Cubrirse, to be coated (pills).
Cucharada, spoonful.
Cucharada de postre, dessertspoonful.
Cucharada de sopa, soup- or table-spoonful.
Cucharadita de té, teaspoonful.
Cuero, leather
Cuidadosamente, carefully, accurately, cautiously.
De día en día, from day to day.
Derecha, right (hand).
Después, after.
De tres en tres días, every third day.
De vez en cuando, occasionally.
Dolor, pain.
El, the (masculine).
En medio de, in the middle of.
Encías, the gums.
Encima, above.
Entre, between.
Esterilizar, sterilise.
Exactamente antes de retirarse para dormir, just before retiring.
Extender, to spread.
Frotar, rub.
Garganta, the throat.
Giro, draft.
Gotas, drops.
Hilas de lino, lint.
Inyección entrevenoso, intravenous injection.
Inyección intramuscular, intramuscular injection.
Inyección subcutáneo, subcutaneous injection.
Jeringa, syringe.
Jugo de limón, lemon juice.
La, the (feminine).
La parte que duele, the painful part
Leche, milk.
Llegado, arrived.
Loción, eye-wash.
Mano, hand
Mañana, por la mañana, to-morrow morning.
Mano llena, handful.

Mañana por la noche, to-morrow night.
Más, more.
Mientras dura el dolor, while the pain lasts.
Mismo, same.
Nariz, nostril.
No, not.
Noche, night.
Oblea, wafer.
Orden (or Pedido), order.
Oreja, ear.
Para inspirar por las narices, to be sniffed up the nostrils.
Para instilar, to be instilled.
Para inyectar, to be injected.
Para ser, to be.
Para uso externo, for external use.
Párpados, eye-lids.
Partes iguales de los dos, of each equal parts.
Pestañas, eye-lashes.
Píldoras (Mézclese y háganse 100 Píldoras). (*Háganse* is frequently contracted to „H”), Pills (mix and prepare 100 pills).
Pintarse, to be painted.
Platearse, to be silvered (pills).
Polvo, powder.
Por la mañana, in the morning.
Potecillo, pot.
Por peso, by weight.
Restregar, to rub.
Rociador y Pulverizador, spray and atomiser.
Romperse, to be crushed or broken.
Rótulo con fórmula, label with formula.
Sanguijuela, leech.
Según se dirige, as directed.
Semana, a week.
Sin, without.
Sitio (or lugar), place.
También, also.
Tapón, tampon.
Taza, cup (drinking) or tea cup.
Todos los días, daily.
Tos, cough.
Una hora s y la otra no, every other hour.
Una gota en el párpado inferior de cada ojo, una vez al día, a drop into the lower lid of each eye once daily.
Una vez, once.
Un día sí y el otro no, every other day
Vaciar, to pour off.
Varilla de vidrio, glass rod.
Veigatorio, blister.
Vena, vein.
Venceno, poison.
Vez una, once (one time).
Visera, eye-shade.
Yema de huevo, yolk of egg.

INDEX & POSOLOGICAL TABLE.

THIS index supplies the name *in Latin* as far as possible and adult dose (if used internally) of most of the drugs and preparations described. The doses are based on personal experience, or are culled from the best authorities.

Official names are printed in *italics*.

For **Acids** look under the word **Acid**.

For **Salts**, *vide* Latin name of the base.

For **Effervescent Preparations**, see list under the word **Effervescent**.

Proprietary or Patent Medicines embodied in pp. 565 - 581 alphabetically are *not* indexed *in extenso* in this index.

Some items, *e.g.*, some Official Medicamenta and Pilulæ have purposely no page—*i.e.*, they are not further described in the book.

N.B.—Figures in heavy type, e.g. 100, refer to Vol. II.

Customary CONTRACTIONS have been found necessary, *e.g.* the following

Acid. or Ac. = Acidus, -a, -um, etc.
 Alc. = Alcoholic.
 Alk. = Alkalinus, etc.
 Av. = Average (Dose).
 Caps. = Capsula, etc.
 C. = cum (with).
 Co. = Compositus, etc. (or compound).
 Conc. = Concentratus, etc.
 Eff. = Effervescens, etc.
 Emplast. = Emplastrum, etc.
 Emuls. = Emulsio, etc.
 Expt. = Expectorant.
 Extr. = Extractum, etc.
 Fluidextr. = Fluidextractum.
 Glycerin = Glycerinum, etc.
 Glyceroph. = Glycerophosphas, etc.
 HBr. = Hydrobromidum, etc.
 HCl. = Hydrochloridum, etc.
 Hy. = Hydrargyrum, etc.
 Hyp. = Hypodermicus, etc.

Inf. = Infusum, etc.
 Inj. = Injectio, etc.
 Incr. = Increased.
 Linim. = Linimentum, etc.
 Liq. = Liquor or Liquidus, etc.
 Mag. = Magnesium, etc.
 Mang. = Manganeseum, etc.
 Mist. = Mistura, etc.
 Potass. = Potassium, etc.
 Quin. = Quinina, etc.
 Rad. = Radix, etc.
 Rep. = Repeated.
 Salicyl. = Salicylas, etc.
 Sol. = Solutio, etc.
 Spirit. = Spiritus, etc.
 Strych. = Strychnina, etc.
 Syr. = Syrupus, etc.
 Tinct. = Tinctura, etc.
 Ung. = Unguentum, etc. or Ointment.
 Vin. = Vinum, etc.
 '85 = B.P. 1885.

Vide also List of Abbreviations Vol. I. p. xxvi., et seq and this Vol. p. xxii.

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„ choline .. Vol. II. 16th edn. p. 219		219	„ „ Liq., 1 to 3 m. 15		15
„ Morphine HCl, $\frac{1}{2}$ to $\frac{1}{4}$ gr., 548; base, $\frac{1}{4}$ to $\frac{1}{2}$ gr.		548	„ „ Liq. et Iodum 1		1
„ -p.-amido-salol, 10 to 15 gr. 95		95	„ As Albumin Test		37
„ -Methyl-Salicyl, 10 to 30 gr.		92	„ Carbonic, 23; Carminic 786, 14		14
„ -Salol, 15 gr.		92	„ Cathartic, 4 to 8 gr. .. 69		69
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			„ Chloracetic. (mono di- tri) 2		2
			„ Cholalic.		71

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„ <i>Chrysophanic.</i> , $\frac{1}{8}$ – $\frac{1}{2}$ gr.	287, 692 & 50	
„ <i>Cinnamic</i> , 1/20– $\frac{1}{4}$ gr.	..	28
„ <i>Citricum</i> , 5 to 20 gr.	31 & 350	
„ <i>Colmaric.</i> ..	..	29
„ <i>Cresotinicum</i> ..	95 & 350	
„ <i>Cresylic.</i> , 1 to 3 m.	..32 & 3	
„ <i>Desoxycholic</i> ..	..	714
„ <i>Diacetic</i> ..	..	363
„ <i>Di-allyl-barbituric</i> , $\frac{3}{4}$ to $4\frac{1}{2}$ gr. ..	..	757
„ <i>Dicamphorylarsinic</i> ..	..	32
„ <i>Digitalic</i> ..	..	60
„ <i>Di-chloracetic</i> ..	..	27
„ <i>Diethylbarbituric</i> ..	..	753
„ <i>Di-iodo-elaidic</i> ..	..	508
„ <i>Di-iodo-p-phenol-sulphonic</i>	496	
„ <i>Di-iodo-Taririnic</i> ..	..	509
„ <i>Dimeth.-arsinic.</i> , $\frac{1}{2}$ to 2 gr.	180	
„ <i>Dimethyl-malonic</i> ..	..	15
„ <i>Di-methyluric</i> ..	..	738
„ <i>Dipropylbarbituric</i> ..	..	757
„ <i>Fillicic</i> , 6 to 15 gr.	420 & 74	
„ <i>Fluoric</i> ..	..	772
„ <i>Formic.</i> , 2–10 m.	38 & 350	
„ <i>Fuchsin.</i> ..	..	539
„ <i>Gallic.</i> , 5 to 15 gr.	..	772
„ <i>Glutaric.</i> ..	..	15
„ <i>Gl tarminic</i> ..	..	95
„ <i>Glycerophosph.</i> , 5 to 10 m.	40	
„ <i>Glycuronic</i> ..	..	400
„ <i>Gymnemic</i>	799
„ <i>Gynocardic</i> , $\frac{1}{2}$ –3 gr.	..	589
„ <i>Hippuric.</i> , 5–20 gr.	8 & 406	
„ <i>Hydriodic.</i> (10%), 5 to 10 m.	..	508
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„ „ <i>Dil.</i> , 10%, 5 to 20 m.	..	48
„ <i>Hydrocyanic.</i> <i>Dil.</i> , 2%, 2–6 m.	49 & 3	
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„ „ <i>Horticultural use</i>	4
„ <i>Hydrofluoric.</i> <i>Dil.</i> , 5–15 m. et Conc...	772, 150	
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„ <i>Hydroxyphenyl-aminopropionic</i>	95
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„ <i>Hyperosmic.</i> , 1/64 gr.	..	773
„ <i>Hypochlorous</i>	49
„ <i>Hypophosphoros.</i>	638
„ „ <i>Dil.</i> , av. 8 m.	..	638
„ <i>Iodic.</i> , 1 to 5 gr.	65 & 351	
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„ <i>Lactic Bacilli</i> ..	69 & 4	

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„ <i>Meconic</i>	773
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„ <i>Meta-vanadic.</i>	829
„ <i>Molybdic.</i>	752
„ <i>Monochloracetic.</i>	27
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„ „ Dil., 10%, 5-20 m:		97	hyp. 10 to 15 grs. ..	756,	237
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„ Trinitrophenic ..		75	927; in Chlorof. Anæsthesia,		
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<i>Benzaminæ Lactas</i> , $\frac{1}{8}$ to $\frac{1}{2}$ gr. .		331	Bile Tests		375
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<i>Benzol</i> , 5 to 10 m. . . .		301	Biniodide Lotion, Solubes and		
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Benzoyl-Acetyl Peroxide . .		7	Bismosal, $\frac{1}{2}$ to 1 dr.		227
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" -Naphthol, 4 to 10 gr. .		552	" Caesium Pot Nit		145
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" -Pseudo-Tropine		328	" <i>Carb.</i> , 5 to 20 gr.		225
" -Salicin		816	" Cinch.iodid., $\frac{1}{8}$ to 1 gr. .		228
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<i>Calumbæ Radix</i>		785	CAPS., Gelatin (G = Gelatin; Gl = Glass)		645
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„ <i>Sulphurata</i> , $\frac{1}{4}$ -1 gr.		256	„ Agrimony Ext.		776
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" Chaulmoogra Oil, 5 to 20 gr. . .		58
" Chemical Food, 1 dr. . .		417
" Chloretone, 5 gr. . .		243
" Chlorodyne, 5 m. . .		286
" Chloroform, 10, 20, 30 & 60 m. (Gl.), 285; and 5 m. (G.) . . .		285
" Chloromorph. Sol., 5 m. . .		286
" Cinnamic Aldehyde, 1 m. . .		29
" Cinnamon Ol., 2 $\frac{1}{2}$ m. c. Quin. 1 gr.		291
" Cod L. Oil, $\frac{1}{2}$, 1 dr. . .		594
" {Cod L. Oil, 19 m., } " {Creosote, 1 m., } " and with Blaud P. . .		594
" Codein c. Ext. Cannabis . . .		340
" Codeinæ et Valerianæ Comp.		340
" Colchicine Salicyl. = $\frac{1}{250}$ gr.		343
" Copaiba, 5, 10, 15 m. . .		601
" {Copaiba, 5, 10 m. } " {Cubeb Ol., 5, 10 m. }		601
" Copaiba, 5 c. Santal, 5 m. . .		601
" Creocarb.		372
" Creosotal, 5, 10 m. . .		374
" Creosote, 3, 5 m. . .		372
" Creosote Valer., 7 m. . .		374
" Cruoris		565
" Cubeb Oil, 10 m. . .		378
" Cubeb, 5, c. Santal Oil, 5 m.		602
" Cyllin, 1 and 3 m. . .		35
" Cyperi Ext. Liq., 5 m. . .		794
" Damiana Ext., (30 m. Liq.)		383
" Distilled Water, Sterile . . .		217
" Dormiol, 8 m.		779
" Easton Syrup = $\frac{1}{2}$ & 1 dr., et aa. c. Arsen., 1/50 gr. . .		419
" Ergot and Apiol . . .		163
" Ergotin, 3 and 5 gr. . .		398

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" Ethyl Bromide (Gl.), 5 m. . .		775
" Ethyl Chlor. (Gl.), 3, 5 Cc., 7 and 50 Cc.		114
" Ethylene Bromide, 1 m. (G.)		775
" Ext. Filicis Liq., 15 m. . .		421
" Fehling's Sol. (Gl.) 1 Cc. . .		400
" Fel Bovinum, 5 gr . . .		407
" Ferri Carb. Sacch. 5 gr. . .		408
" Ferri Glyceroph, Co. 1 t.d.		42
" Ferri Oleatis, 5 gr. . .		586
" Formalised Gelatin . . .		645
" Formidin, 5 gr. . .		495
" Geosote, 2, 5 m. . .		377
" Glutoid		492, 645
" Glyceroph. = $\frac{1}{2}$ dr. & 1 dr. of Syrup		45
" Gonol		601
" Guaiac Resin, 5 gr. . .		442
" Guaiacol, 2, 5 m. . .		375
" " 1 gr., c. Iodoform, 1 gr.		375
" Guaiacol, $\frac{3}{4}$ gr. c. Cod L. Oil, 5 m.		375
" Guaiacol Valer., 2, 5 m. . .		377
" Gynocardia (Chaulmoogra), 5 to 20 gr. . .		587
" Hæmoglobin, 5 gr. . .		566
" Holadin		621
" Hydrastis = 30 m Ext. Liq. . .		475
" Hydriodol = $\frac{1}{16}$, $\frac{1}{32}$ gr. . .		457
" Hypnone, $\frac{3}{4}$ min.		2
" Ichthyol, Amm., or Lith., 4 gr. also aa., 2 gr. . .		488
" Iodacin, 3 gr.		599
" Iodinol 25%, 2 gm. . .		499
" Iodoform (glutoid) . . .		492
" Iron Carb. Sacch., 5 gr. . .		408
" " Iodide = 10 & 30 m. Syr.		416
" Izal 2 m. (& with Cod Liver Oil, 5 m.) . . .		63
" Kerol		63
" Lecithin, 1 $\frac{1}{2}$ gr. . . .		525
" Lymph Co.		932
" Male Fern Ext., 15 m. . .		421
" Magnes. Oleat, 10 gr. . .		587
" Menthol Paraffin . . .		540
" Meth. Blue, 2 gr. (and Comp.)		311
" Myrtol, 2 and 5 m. . .		811
" Nisbet's Specific, 20 m. . .		602
" Nitric Acid, 1 m. (Gl.) . . .		370
" Nitrite of Amyl (Gl.), 1, 2, 3, 4, 5, 6 & 10 m. . .		146
" Nitroglycerin, 1-100 and 1-50 gr.		558
" Ol. Allii, $\frac{1}{2}$, 1, 2 m. . .		777
" " Cedri Atlant, 8 m. . .		788
" " Chaulmoogra, 5-20 gr. . .		589
" " Elliott, $\frac{1}{2}$ m. (three to 5)		813

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" " Papav., 15 m. ..		598	and Bandages, 16; Iodine		
" " Turpentine, 5, 10 m. ..		646	Sol., 17; Resin, 18; Smelling		
" Oleic Acid, 7½ m. ..		582	Salts, 18; Wool		16
" Olive Oil, ½, 1 dr. ..		596	" Carbon "		553
" Ox Bile, 5 gr. ..		407	Carbon Bisulphidum, 786; Di-		
" Ovomammoid		916	chloride, 287; Dioxide, 23,		457
" Papaveris		604	Electrical Properties of, 26;		
" Paraffin (for Catheters) ..		627	Alveolar, Tension		54
" Paraldehyde, 20, 30, 40 m. ..		123	Monoxide, 457; Tetrachlor		786
" Pavimol, 15 m., 2 to 4			Carbonic Anhydride		23
twice daily		598	Carbonic Snow		23
" Phosphorated Oil, 5 m. ..		636	Carbonite		556
" Poppy Seed Oil, 15 m... ..		598	Carbonyl Chloride		752
" Potass Iodide, 5 gr. ..		661	Carborundum, 290; Carbure-		
" Potass Permang., 1 gr... ..		536	tted Gas		457
" Quin. Salicyl., 5 gr. ..		672	Carcinoma. See Therap Index and		469
" Sulph., 1-5 gr. ..		673	Cardamomi Semina		786
" Sahli's		492, 645	Wild		831
" Salol, 5 and 10 gr. ..		93	Cargile Membrane		912
" Santal and Kava		603	Carica Papaya		621
" Santalol, 5 m. ..		601	Caries Dental		104
" " 4 m. c. Methyl			Carlsbad Salt, True and Artif..		712
Salicyl., 1		601	Carmalum	786 &	390
Santalol, 5 and 10 m. c.			Carmeliter Geist		808
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½, 1 and 2 gr. ..		601	Carnauba Wax		252
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" Savaresse, 10 m. ..		601	Carnrick's Peptonoids	633 &	567
" Sod. Cacodylate = ¾ gr.			Carrel-Dakin Treatment	59,	310
Acid (Gl.)		182	Carter's Little Liver Pills ..		567
" Sod. Chaulmoograte 'A,'			Carrageen, 790; Carron Oil ..		255
1, 2 and 3 gr. ..		591	Cartilage, Hyaline		565
Sodium Oleate, 5 grs... ..		689	Carui Fructus		787
" " Co., m.et n. ..		689	Carum Copticum		743
" Spermin (Gl.), 1 Cc. ..		932	Carvacrol, 813; Carvol, Carvo-		
" Sulphonal, 5, 10 gr. ..		727	num		787
" Syr. Fe. Ph. Co., 1 dr... ..		417	Carwardine's Saccharometer ..		401
" Terebene, 5 and 10 m... ..		735	Caryophyllum		787
" Terpinol, 1½ m... ..		735	Casca Bark		403
" Trypsin et c. Fel. Bov. ..		621	Cascagar, 1 teaspoon to 1 table-		
" Turpentine, 5, 10 m. ..		646	spoon		266
" Valerianatum Co., 1 t.d..		679	Cascara, 3 to 15 gr.	268 &	49
Capsuloids		567	" Caps., 268; Pastils. ..		270
' Capsungs ' Hydrarg. Oleat Ung.		583	" Jelly, 1 to 4 dr.		268
Captol		276	Cascarilla, Cascarillin		787
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Caraway		787	Medium	549,	560
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" Thionin		556	" Fructus		787
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" Coefficient		342	Castellani's Antimon. Tart.		
" of Oils		114	Injn., ½ to 1 Cc.		157
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" Gauze.. ..		16	Castille Soap		142

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<i>Castor Oil</i> , 1 to 8 dr.	598	„ „ Lange's Gold Test	395
Castor Oil Powders	599	Cereoli <i>vide</i> Bougies.		
„ Solutions of Alkaloids	599	Ceresin	623
Casts	393	Cereus, Night-blooming.	788
Catalase	69	Cerevisiæ Ferment., $\frac{1}{2}$ -1 oz.	273
Cataplasma Kaolini	429	Cerii Oxalas, 2-10 gr.	788
Cataplasma Salicyl. Co.	430	„ Oxidum	50
Catarrh, Vaccines for	846	„ Sulphocarb., 1-5 gr.	789
<i>Catechu Pallidum</i> , 5-15 gr.	788	Cerium 50, & Cancer	469
„ <i>Nigrum</i> , 5-15 gr.	788	Ceruleinum	53
Catgut Ligatures	526	Cerussa, 654; Cestrum Parqui	789	
Catha	271	<i>Cetaceum</i>	789
„ Cocoa Milk	272	Cetraria (Cetrarin, 2-4 gr.)	789, 150	
„ Milk and Glyceroph.	272	Cetyl Alcohol (and Palmitate)	789	
„ Phenolphthalein Eff.	272	Cevadilla Seeds, Cevadine	762	
Catheters, Sterilisers, etc.	264	Ceyssatite, 137; Chalk's Bottles	214	
Catheter Oil, 16; Salol Oil	94	Chalk, Camphorated	258
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„ Barii	220		Charcoal (Animal, Wood, etc.)	786	
„ Zinci Chloridi	763		Charta Hydrargyri bichlor, 465; Sinapis (Sinapizata)	694	
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Celloidin and Sol.	343, 344		Chelidonium Majus	789	
„ 'Sacs'	55		Cheltenham Water	436	
Cellon	50		Chelsea Pensioner, 1 to 2 dr.	729	
Cellotropine, $\frac{1}{2}$ to 1 Gm.	781		Chemical Food, $\frac{1}{2}$ -2 dr.	417	
Cellulase	69		Chemotherapy	189	
Celluloid, 345; Splints	345		Chenopodium	790	
Cellulose Acetate	440		Cheron's Serum	701	
Cellulose Films	436		Cherry Bark, Wild	816	
Wadding and Tissue	436		Cherry <i>Laurel Water</i>	145	
Celmo	567		Chestnut (Horse)	774	
Cephaeline (and HCl.), Emetic 1/12 to 1/6 gr.	519		Chian Turpentine	828	
Cephaelis	510		Chicken Ess., Peptones	564	
<i>Cera Alba, Flava</i>	788		„ Jelly	619	
„ Aseptica	788		„ Pox	940	
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Cerebro-Spinal Fever	849, 475		Chinese Almond, 780; Ink	514	
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„ „ Fluid Perman-ganate Test of C.S. Fluid	476		Chinoform, 1 to 5 gr.	306	
			Chinolini Tart., 5to 15 gr.	306	
			Chinolinum, 3 to 10 m.	307	
			Chinosol, 1 to 5 gr., 306; Gauze	790	
			<i>Chirata</i> , 790; Japanese	275	
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			„ Antipyrin	246	
			„ Caffeine hyp. 3-8 gr.		

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Chloralamid, 15 to 45 gr. ..		277	Chondro-Albumin ..		367
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Chloratificrice ..		659	Christmas Rose ..		830
Chlorazene ..		60	Christopherson's Bilharzia Treat- ment ..		158
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Chloretone, 5 to 24 gr. ..		242	Chromo-radiometer ..		298
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„ c. Ethyl Iodide, Sterules. ..		115	Cicatricine, 8 to 15 m. ..		695
„ Inhalers ..		279	Cicuta, F.E. = Conine; C. <i>Virosa</i> ..		790
„ -Oxygen-Anæsthesia ..		281	Cicutine, $\frac{1}{8}$ to 2 gr. ..		368
„ Sickness ..		282	Cigarettes, Asthma, 662; Cu- beb, 378; d'Espic ..		662
„ Sterules, 10, 20, 30, 60 m., and G, 5 m. ..		285	Cigue ..		367
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„ Camphorat ..		285	Cimicifugæ Rhizoma, 15 gr. ..		790
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„ Culture Medium ..		852, 560	„ Sulph., $1\frac{1}{2}$ -10 gr. ..		791
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<i>Cod Liver Oil</i> , 1 to 4 dr. ..		592
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„ „ Substitutes		595
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Codeinæ HBr. ¼ to 2 gr. ..		340
Codeinæ HCl., ¼ to 2 gr. ..		340
<i>Codeinæ Phosphas</i> , ¼-1 gr. ..		340
„ Sulph. av. ½ gr. ..		341
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'COLLAPSUBES' OF OINT- MENTS p. 11:—			<i>Collodium</i> c. Iodoform ..		492
† „ Aristol, 10% ..	495		„ Paraformi ..		130
* „ Atropine, 1 in 120, &c. 215			„ Kelly's ..		344
* „ Atrop., 1% & Cocain. 2% ..	215		„ 'Sacs' ..		55, 391
* Atrop. & Iodof aa. 1 in 120 ..	215		„ Salicyl ..		344
* Atropine, 1 in 120, c. Ung. Hyd. Ox. Flav. 4% ..	215		„ Salicyl. et Lact. ..		344
1 „ Bism., Morph. Coc. ..	226		„ c. Hyd. Perchlor ..		344
„ Bism. Subgallate ..	236		„ c. Zinc ..		344
* „ Boric Acid Oint. ..	11		„ Salol, 94; Styptic ..		344
* „ Boric Acid in White Vaseline, 1 in 60 ..	11		„ <i>Vesicans</i> ..		263
**†§ „ „ Vaseline ..	12		„ Zinci Chloridi ..		763
† „ Dermatol, 10% ..	236		Colloidal Metals ..		345
§ „ Ferri Perchlor. ..	410		(see also Iontophoresis, 269).		
§ „ Gall and Opium ..	609		„ Antiseptic Powers ..		353
§ „ Hamam. (et c. Cocaina) ..	444		„ Characters ..		346
* „ Homatropine and Cocaine, ea. 2% ..			„ Doses, see individual Solutions in text.		
† „ Hyd. Iodid, 1% ..	457		„ Manufacture, Methods previously published		349
„ Hyd. Zinc Cy. $\frac{1}{2}$ to 2% ..	456		„ Author's Chemical ..		354
„ Hydrarg. Salicyl. ..	469		„ Author's Electrical ..		363
„ Hydrastis (5% Liquid Extract). ..			„ Metal Organsols ..		365
**†§ „ Iodoform, 5%, et Cocaina, 2% ..	494		„ Patents on ..		351
† „ Iodoform, et Eucalypt. 5% ..	494		„ Physiological Expts. ..		355
†§** „ Iodol, 5%, et Eucalypt. 5% ..	496		„ 357 358 359, 360 ..		361
†§** „ Lanolin & L. Cream ..	428 & 459		„ References ..		366
* „ Lubric. Jelly ..	80		Colloidal Solutions, Antimony ..		354, 363
* „ Methysal Balm ..	80		„ „ AntimonySulphide ..		354
* „ Pagenstecher's, 1.25 to 10% ..	473		„ „ Arsenic ..		354
„ Petroleum Cerate ..	624		„ „ Copper (1 in 2000) ..		354
† „ Picric Acid, $\frac{1}{2}$ % ..	77		„ „ Phosph. ..		356
† „ Silver Proteinat ..	171		„ „ Gold (1 in 4000) ..		356
** „ Surgical Lubricant ..	16		„ „ Test in C.S. Fluid ..		395
† „ Tannin, 10% ..	—		„ „ Iodine ..		357
† „ Thallin, 5%, c. Cocaine 2% ..	317		„ „ Manganese ..		358
„ Ung. Prophylaxis ..	453		„ „ Mercury (1 in 2000) ..		359
**†§ „ Vaseline ..	624		„ „ Platinum (1 in 4000) ..		360
† „ Zinc Permang., 1 in 2000 ..	538		„ „ Selenium (1 in 5000) ..		360
† „ Zinc Sulph., 1 in 500 ..	768		„ „ Silver (1 in 2000) ..		361
† „ Zinc Sulphocarb., 1 in 500 ..	—		„ „ (Collargol) ..		170
Collodium Callosum ..	344		„ „ Sulphur (1 in 1000) ..		362, 729
„ Cantharidis (var.) ..	263		„ „ Verification ..		348
„ Benzoini ..	344		„ „ Therapy ..		353
„ Cocainæ, 2% ..	320		„ „ Uses ..		354
„ c. Ol. Crotonis, 1 in 7 ..	344		Collosols, Argent, 361; Hydrarg. 362. <i>et seq.</i> ; Iodine, 357; Manganese, 358; Palladium, 359; Selenium, 361; Sulphur ..		362
„ Elasticum ..	344		Collunarium Alum. T.H. 1% ..		
„ <i>Flexile</i> ..	344		„ Pot. Permang., Liq. 6 m. in 1 oz., T.H. ..		
„ Ichthyol ..	488		Collunarium Potass. Chlorat. Co. ..		659
„ Iodi, 30 gr. in 1 oz. ..	344		Collunarium Quininae ..		676
			„ Zinc Sulph 0.1% ..		
			Collunarium Zinc Sulphocarb. 1 in 250. ..		—

Those marked * are of small size for ophthalmic use.

† Are for urethral use. § For rectal use.

** For vaginal or uterine use. The last three with suitable attachments.

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Collutorium Acidi Benzoici ..		6	Copal Solution ..		807
„ Alkalinum Co. ..		704	Copper Alanin ..		382
„ Astringens ..		763	Copper Comps. Organic, 382;		
„ Formalini ..		127	„ Colloidal ..		349, 354
„ Hydrogen Perox. ..		478	„ Fun <i>gi</i> ides ..		58
„ Pot. Permang. ..		537	„ Hair Dye ..		29
Collyr. Adstring. Lut. ..		767	„ Lecithin ..		525
Collyr. Hyd. Biniodidi. ..		456	„ Points ..		381, 768
<i>Colocynth, Pulpa</i> , 2 to 8 gr. ..		366	„ Salvarsan ..		209
Colocynthin ..		367	Copra ..		96
Colon Bacillus ..		855	Coptis Teeta, 792; Cordite ..		557
Colostrum ..		450	Coquelicot, Fleurs de ..		604
Comfrey ..		826	Corallin ..		172, 464
‘Complement’ ..	834 &	5.5	Corcnorus Capsularis ..		792
Comp. Asthma Fluid ..		213	<i>Coriander</i> ..		792
Conarium ..		917	Cordova's Modafd. Eusol ..		55
Concretes ..		112	Corn Ergot Oil and Silk ..		807
Condurango, 15 to 60 gr. ..		791	Corns, Collodions for ..		344
Condy's Fluids ..		538	Cornutine $\frac{1}{2}$ to $\frac{1}{4}$ gr, <i>p.d.</i> ..		398
Confectio Aromatica = Pulv. Cretæ			Coronilla ..		792
„ Aromatica, 10-60 gr. ..		607	Coronium Bromide ..		720
Confectio Emblicæ, 1-2 dr. ..		795	Corpora Lutea, 5 to 10 gr. ..		913
„ Glyceroph Co., 1 to 2 dr. 44			Corrobativ <i>e</i> Tests Organic ..		236
„ c. Malt, 1 to 2 dr. ..		45	Corrosive Sublimate ..		461
„ Guaiaci Co., 1 dr. ..		729	Coscinum, 785; Coster's Paste ..		500
„ <i>Piperis</i> , 60-120 gr. ..			Costos ..		792
„ <i>Rosæ Gal.</i> ..		819	Cotarnine Base ..		554
„ Rutæ, 1 to 2 dr. ..		820	Cotarnine HCl., $\frac{1}{4}$ to $\frac{1}{2}$ gr. incr.		
„ Santonini Co., 1 dr. ..		688	554; Phthalate, $\frac{3}{4}$ gr. incr. ..		555
„ Scammonia Co., '85, 10			Coto Cort., 1 to 8 gr. ..		369
„ to 30 gr. ..			Cotoin, $\frac{1}{2}$ to 2 gr. ..		370
„ <i>Sennæ</i> , 60-120 gr. ..		693	Cotton Medicated ..		436
„ <i>Sulphuris</i> (et c. Senna)			„ Seed Ext. Pdr., 1 dr... 441		
„ 60 to 120 gr. ..		729	„ Meal ..		99
„ Terebinthinæ '85, 60			<i>Couch Grass</i> , 491, 776Coulomb		270
„ to 120 gr. ..			Coumaric Treatment ..		29
„ Vitelli, Cerevisiæ et Lim.			Coumaric Anhyd., 370; Coumarin		370
„ Succ. $\frac{1}{2}$ dr. ..		579	Court Plaster, 802; Cowbane.. 790		
Congo Red Blood Serum, 852;			Cowhage, 1 to 2 gr., 421; Cow-		
Paper, 459, 460 ; for Spiro-			pox, 903; Crab's Eyes =		
chætes 515 ; and as Indicator			Calcii Carb. ..		
in Vol. Analysis ..		170	Coza Powders ..		568
Congreve's Elixir ..		563	Cramer's Glucose Test ..		404
Conjunctivitis ..		971, 506	Craie Préparée ..		248
Conii Folia and fruits, 2 to			Cranesbill Root..		798
8 gr. ..		367 & 58	Cream Assay, Preservation,		
Conine, $\frac{1}{4}$ gr. incr. ..		368 & 58	thickeners, etc ..		452
Coninæ, H Br., HCl. $\frac{1}{3}$ gr. inc.		368	„ Cold ..		600
Conradi's Koleradraaber ..		369	„ of Malt preparations ..		533
Conradi Drigalski Medium ..		425	„ Salicylic ..		82
Contents ..		iii	„ of Tartar (Soluble, 664),		
Contractile Collodion ..		343	20 to 60 gr. ..		663, 139
Convallaria Majalis ..		792	Creatinin, Creatin ..		395
Convolvulin, 1 to 5 gr. ..		523	Crédé's Silver (Ung. 170), $\frac{1}{2}$ to		
Convolvulus Purp. ..		802	2 gr. ..		170
Coolidge “X” ray tube ..		239	Cremor Acid Salicyl ..		82
Cooper's We dicide stated to			„ Frigid ..		600
contain 36% of Arsenious			„ Hamamelidis ..		443
Oxide by weight. Inquest on			„ Lowndes ..		453
Mrs. Greenwood, June 16/20.			„ Magnesiæ, 1 to 4 dr. ..		530
Coorchi ..		792	„ “Sicc” preparations ..		748
<i>Copaiba</i> , 30 to 60 m. ..		602, 123	„ Zinc (et Calaminæ) ..		765
„ Oil, 5 to 20 m. ..		602	Creo-Camph. Cream ..		449
„ Resin ..		602	Creocarb. Capsules ..		372
„ Soluble ..		603	Creolin Pearson ..		34

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Creocamph.	207	Cupri Glycinas	382
Creophen	34	„ Hippuras	382
Creosotal, 5 to 20 gr.	374	„ Nucleinas..	275
Creosote Carbonate, 5-20 gr.	374	„ Oleas . . . . .	.. ..	582
„ Phenyl Propion, 10 m.	374	„ Oxidum . . . . .	.. ..	380
„ Valer., 4 to 12 gr.	374	„ Subacetas . . . . .	.. ..	380
Creosoted Oil	627	„ Sulphas.. $\frac{1}{4}$ to $\frac{1}{2}$ gr.; emetic	.. ..	380
Creosotum, 1 to 5 m. incr., 370 & 58; Cresol, 1 to 3 m.	32, 3	„ Sulphocarbolas . . . . .	.. ..	19
Cresineol	72	Cupric Test Pellets . . . . .	.. ..	399
Cresol Paste	33	Cuprol . . . . .	.. ..	275
„ Soap Soln. for vermin..	36	Cupro-Uranite . . . . .	.. ..	751
Cresylic Disinfectants	33, 344		Cuprum, 380, 58; Aluminatum	.. ..	2
Cresyl hydrate	32	“Cuprung” . . . . .	.. ..	380
Creta Gallica	137	Curara, $\frac{1}{160}$ th to $\frac{1}{2}$ gr. . . . .	.. ..	793
„ Preeparata, 15-60 gr.		Curarina, $\frac{1}{400}$ to $\frac{1}{10}$ gr. . . . .	.. ..	793
Crile's Anoci-Association 109, 140, 485		Curdled Milk	69 & 4 et seq.	
Crile's Tube	281	„ „ Medicated . . . . .	.. ..	72
Crinoline Bdgcs.	255	Curdling Ferment . . . . .	.. ..	617
Crippen Case	83	Curd Soap	689, 142	
Crocus	792	Curic Wafers, 568; Curicones	.. ..
Crooke's Colloids	351	568; Cusso, $\frac{1}{4}$ to $\frac{1}{2}$ oz. . . . .	.. ..	258
Crosby's Balsamic Elixir	568	Curschmann's Solution, 15 m. . . . .	.. ..	258
Crotalin, 913; Crotin	813	Cusparia . . . . .	.. ..	793
Croton-Chloral Hyd., 5 to 20 gr	241	Cutch, <i>see</i> Catechu nigrum . . . . .	.. ..	788
„ Eluteria	787	Cuticura, 568; Cutol . . . . .	.. ..	100
„ Gubouga	149	Cyanamide	45, 150	
„ Tigilium	812	Cyanide Gauze, 455; Paste . . . . .	.. ..	456
„ Elliottianus	813	Caynides in Water to Detect.. . . .	.. ..	420
Crowe's Egg Medium..	559	Cyanuretum Hydrargyri . . . . .	.. ..	454
Cryogenin, 3 to 24 gr.	8	Cyclic Ureides . . . . .	.. ..	753
Cryoscopy, Vol. II. 16th Edn. 223; Cryptopine	124	Cydoniæ Semina . . . . .	.. ..	793
Crystal Violet	308, 310, 549		Cyllin, Preps., 1 to 5 m. 34, 35, 344	.. ..
Crystalloids	346, 269	Cymene, 526; Cyna . . . . .	.. ..	687
Cubeb Cigarettes	378	Cynips Gallæ . . . . .	.. ..	798
Cubebæ Fruct., 30-60 gr.	378, 600	Cynoglossum, 793; Cynotoxin. . . . .	.. ..	164
Cuca, <i>see</i> Coca.		Cyperus Rotundus . . . . .	.. ..	794
Cucumber Ointment	792	Cypridol (Capsules), 1 or 2 . . . . .	.. ..	457
Cucurbitæ Semina Præp., 3 to 4 oz.	793	Cypripedin, 2 to 3 gr. . . . .	.. ..	794
Cudbear	89	Cystamin, 5 to 15 gr. . . . .	.. ..	444
Culex Imp., Pip. Pungens, etc., 493, 495, 555		Cystazol Tabs., 1 to 3 in water . . . . .	.. ..	446
Culture Media	553	Cystin	393, 395	
Cultures Standard for Diagnosis	547	Cystoformin . . . . .	.. ..	447
Culvers Root	805	Cystogen, 5 to 15 gr. . . . .	.. ..	444
Cumene	526	Cystopurin, 30 gr. . . . .	.. ..	447
Cupralgin = Cupri-Alginas	776	Cytase . . . . .	.. ..	516
Cuprase	356	Cytisine, 794; Cytisus Labur- num . . . . .	.. ..	794
Cuprea Bark	378	Cystisus Scoparius . . . . .	.. ..	715
Cupreine and Comps.	378	Cytolysin . . . . .	.. ..	833
Cuprentum	380	Daisy Powders . . . . .	.. ..	568
Crystallography in chemical analysis,— <i>vide</i> Li. i/17, 798		Dakins' Hypochlorite Solution (Stronger) . . . . .	.. ..	56
Cupri Acet., 1-12 to $\frac{1}{2}$ gr.	380	„ „ (Weaker) . . . . .	.. ..	57
„ Alanin	382	„ „ Bacteriologi- cal Power 58, 354	.. ..
„ Alginas $\frac{1}{4}$ to $\frac{1}{8}$ gr.	776	„ „ Uses . . . . .	.. ..	58
Cupri Alloxanas	382	„ „ Daufresne's Modfn. . . . .	.. ..	59
„ Amino-propionas	382	Dalby's Carminative . . . . .	.. ..	569
„ Ammon, Sulph.	380	Damaroids . . . . .	.. ..	569
„ Arsenis, $\frac{1}{160}$ th to $\frac{1}{5}$ th gr.	178	Damiana, 382; Dammar . . . . .	.. ..	794
„ Aseptol	19	Dämmerschlaf . . . . .	.. ..	483
„ Chloridum, $\frac{1}{4}$ to 2 gr. 382, & 354		Dandelion	827
„ Citras	380	Dangerous Drugs Bill	951

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Danysz "102", 207; Daphne		809	Departmental Committee's Re-		
D'Arson val's Amperemeter ..		270	port on Cocaine in Dentis-		
Dark Ground Illumination ..		513	try		322, 952
Datura var.		487, 719	Dermatol		235
<i>Daturæ Folia et Semina</i> ..		719	Dermogen		480
Daturina and Sulph.		719	Desoxycholic Acid		714
Daufresne's Modfd. Dakin Soln.		59	Detoxicated Vaccines ..		909
Dearborn Preps.		569	Developer, Photographic ..		291
Deba		753	Devil's Milk		796
De Carle Woodcock's Reaction		898	Dewees's Mixture, $\frac{1}{2}$ oz. ..		132
Decalcified Dietary		252	Dextrin		427
Dechlorination		702	Dextrin Injection Intrav. ..		771
Decocta Concentrata		383	Dextro Pinene		136
Dec. <i>Acaciae</i> Cort., $\frac{1}{2}$ to 2 oz. ..		771	Dextrose, 425; Enema ..		394
„ <i>Agropyri</i> , $\frac{1}{2}$ to 2 oz. ..		776	Dhobie's Itch		478
„ <i>Apocyni</i> , $\frac{1}{2}$ to 1 oz. ..		164	Diabetic Foods, 576; Urines, 398;		
„ <i>Cetrariæ</i> , '85, <i>ad lib.</i> ..		789	Diabetin		687
„ <i>Chondri</i>		790	Diacetyl Tannin, 5 to 15 gr. ..		100
„ <i>Cinchonæ</i> , '85, 1 to 2 oz. ..		290	<i>Diacetyl-Morphine HCl.</i> , $\frac{1}{2}$ to		
„ <i>Cydoniæ</i>		793	$\frac{1}{8}$ gr.		548
„ <i>Eucalypti</i> , 2 to 4 dr. ..		796	Diachylon Plaster		584
„ <i>Euphorbiæ</i> Pepli, 1 tea-			Dial Tabs., $1\frac{1}{2}$ gr. Dose, $\frac{1}{2}$ to 3		
cup		796	Tabs.		757, 243 & Chart
„ <i>Granati</i> Cort., B.P. '98, 1			Diamalt and with Oil		533
in 5, $\frac{1}{2}$ to 2 oz.			Diamide		25
„ <i>Hæmatoxyli</i> , $\frac{1}{2}$ to 2 oz. ..		803	Diamido-azo-benzene HCl. ..		311
„ <i>Ispaghulæ</i> , $\frac{1}{2}$ to 2 oz. ..		806	Diamidodiphenyl		379
„ <i>Lini</i>		806	Diamidophenol HCl. = Amidol		291
„ Papav. et c. Anthem. ..		604	Diamino-Acridine Sulphate, 298;		
„ <i>Paireæ</i> , '85, 1 in 16, std.			Patents, 299; Antiseptic		
hot, 1 to 2 oz.			Power, 299; Oleate, 299;		
„ <i>Psyllii</i> , <i>ad lib.</i>		816	Uses		300
„ <i>Quercus</i> , 1 to 2 oz. ..		818	Diamino-diselenobenzene HCl.		731
„ <i>Sappan</i> , $\frac{1}{2}$ to 2 oz. ..		799	Diamino-Methyl-Acridine Chlor.		292
„ Sarsae and Co., '85, 2 to 1			<i>Diamorphinæ Hydrochloridum</i> ,		
10 oz.		691	1/15 to 1/8 gr.		548
„ <i>Scoparii</i> and <i>Tarax.</i> , '85,			Dia-Paraffin		533
2 to 4 oz.			Diaphanite		238
„ <i>Simarubæ</i> et <i>Granati</i> , 1 oz.			Diaphorm, 1/25 to 1/8 gr. ..		548
823, 151			Diarrhœa, Hill, Mixtures ..		369
„ <i>Tritici</i> , $\frac{1}{2}$ to 2 oz. ..		776	„ Schmidt's Test		486
„ <i>Ulmi</i> , 2 to 4 oz.		829	Diascordium		828
„ <i>Zittmanni</i> F. et Mit. ..		692	Diapsirin		86
Defence of Realm Cocaine			Diastase, Malt, <i>syn.</i> Maltine		532 & 90
Regulation, 949; Narcotics ..		953	„ Pancreatic		617, 90, 127
DeLafield's Hæmatoxylin ..		390	Diastasic Power, Expts. on ..		90
Delectol and Deliciol		626	„ Test (Urine)		369
Delhi Boil		492	Diathermic Treatment		302
Delphina, $\frac{1}{4}$ to $\frac{3}{4}$ gr.		825	Dibromfluorescein		386
Dengue Fever		555	Dibromodinitro-fluorescein ..		387
Dental Anaesthetic, 10 to 25 m.			Dibromo-oxy-Mercury-Fluorescein		81
„		321, 326	Dichloramine-T		62
„ Arsenical Fibre & Paste ..		177	„ in Eucalyptol		63
„ Compo		803	Dichlorethylene		287
„ Dressings, Sterile		440	Dichlorethyl-sulphide		1023, 458
„ Extractions		321	Dichloride of Ethylene		287
„ Fillings		767	Dictamnus Fraxinella		794
„ Mastich, 807; Plasters,			Didymine, 932; Didymium ..		50
266, 267; Rubber		265	Dielectric Oil, 1 dr. to 2 oz. ..		363
„ Solubes, Antiseptic, 18;			Diethylamino propyl Cinnamate		339
Wax		624	Diethyl barbituric Acid		753
Dentalone		243	Diethylene-diamine, 4/10 gr. ..		649
Depilatories		220, 256, 713	Di-ethyl Malonate		754
Dentists Act Committee Report		952	Di-ethyl-malonyl-urea, 5 to 10 gr.		753

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
<i>Diethyl-sulfone-methyl-ethyl-methane</i> , 10 to 20 gr.		727	Dimethyl Meth-dieth. Sulphone		672
Diets, Animal Expts.		96	„ -oxy-quinizine		313
Diffusol		35	„ Xanthine		736
Digalen, 5 to 15 m.		392	Dimmock's Test		404
Digestin, 1½ to 5 gr.		535 & 69	Dinitrobenzols		303
Digestive Salt		703	Dinitro-cellulose		343
Digistrophan Tablets		392	Dinner Pills and Tablets		655
Digitalein		389 & 61	Diogen (developer <i>v.P.J.i./07,429</i>).		
Digitaline, Cryst., $\frac{1}{100}$ to $\frac{1}{100}$ gr.		390	Dionin, $\frac{1}{4}$ to $\frac{1}{2}$ gr.		547
Digitaline, Amorphe, $\frac{1}{10}$ to $\frac{1}{10}$ gr.			Di-ortho-Aminothio Benzene		413
Granules, 1 mgr.		389, 390	Dioxogen		479
Digitalinum Nativelle granules, $\frac{1}{40}$ and $\frac{1}{100}$ gr.		390	Dioxibenzol-hexamethylenctramine, 8 to 30 gr.		447
„ Pulv. Pur., $\frac{1}{10}$ to $\frac{1}{2}$ gr.		391	Dioxydiamino - Arsenobenzol HCl.		187
<i>Digitalis, Folia</i> , $\frac{1}{2}$ to 2 gr.		383, 59	Dioxytoluol		406
„ Acetone Extractive		60	Diphenylamine		418
„ Assay, 62 <i>et seq.</i> ; Martindale's Color Method Table <i>opposite</i>		63	„ Eth-thymyl benz.		747
„ Botanical Diffs.		59	Diphenylchlorarsine		458
„ Cultivation		59	Diphenylcyanoarsine		458
„ Cumulative Action		387	Diphtheria Antitoxin	856,	481
„ First and second years' leaves compared		59	„ 'Conc.' 857; Units		481
„ Flowers		68	„ Serum Rashes, Oral and rectal use and general refs.		482, 483
„ Frohde's, Keller's and Kiliani Tests		61	„ Bacillus, Swab, Carriers		478, 479
„ Glucosides, 389, 60, 149; Leaf and Seed		61	„ Endotoxin	858,	483
„ Indian		66	„ Infective Period		940
„ Physiological Standardisation	388, 62, <i>et seq.</i>		„ Pigment for		410
„ Preservation		59	„ Prophylactic		858
„ Seeds		68	„ Schick Test for		482
„ Season for Collection 59 <i>et seq.</i>			Diplo. Intracellularis		851
„ Tinctures, Chemical and Phys. Standn. compared, 63; 1920 Results		66	„ Neutral Red Medium for		872
Digitalone, hyp. 8 to 15 m.		388	„ Rheumaticus		872
Digitoflavone		61	„ Still's		851
Digitsaponin		61	„ Various		490
Digitonin		61	„ Wiechselbaum	850,	851
Digitoxin, $\frac{1}{100}$ to $\frac{1}{4}$ gr. (granules $\frac{1}{4}$ mgr.)		390, 391, 61	Diplorhynchus		79 4
Di-hydroxybenzene		681	Diplosal, 15 gr.		81
Dihydroxyphenylethyl Methylamine		931	Disaccharides		94
Dihydroxyphenylserines		154	Diseases Index		959
Dihydroxyphthalophenon		634	Diselenophenylarsonic Acid		731
Di-Iodo Cocaine HCl.		325	Disinfectants 'C,' &c 34, 125, 130, 536		
Di-iodo-iso-propyl-Alcohol		508	„ Mechanism of		347
Di-iodo-hydrin		508	„ Standardisation Chapter		342
Dimatos		136	„ Summary of Potent		942
Dimethyl-Amido-Antipyrin		315	Disinfection of Rooms 125, 130 and		355
„ „ Azo-Benzol		170, 461	Disinfector, Formanganate		125
Dimethyl-Amidobenzaldehyde		407, 509	Di-Sodo-Luargol		207
„ Benzol		303	Di-Sod. Methylarsen., $\frac{2}{3}$ to 3 gr.		181
„ -diamido-tolu-phenaz. HCl.		424	Distilled Water, Bact. Examn.		421
„ -Ethyl-carbinol		778	Disuccinyl-diox., 2 gr.		97
„ -Ethyl-carbinol-chloral		779	Dita Bark and Ditaine		778
„ Glyoxime		150	Di-thymol-iodide		494
„ -Ketone, 1-1½ dr.		2	Di-Ureides		753
			Dmagon Vaccine		862
			Diuretic, the choice of a		385
			Diuretin, 10 to 20 gr.		737
			„ Lithium, 5 to 15 gr.		737
			Divi Divi		794
			Doan's Pills and Ointment		569

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE
Dobell's Solution	704
Dock, Yellow	820
Dodd's Pills	569
Dogwood, Jamaica	476, 816
Dolichos Pubes	421
Donald's Method	421
Donovan's Sol., 5 to 20 m.	177
"Dope"	440
Doremus Ureometer	414
Dormigene, 5 to 10 gr.	758
Dormiol (Caps. 7½ m.), 5 to 50 m.	779
Dorset's Egg Medium	559
Doses, Metric, and Imperial	XXXII. and XXXIV.
Douches, Nasal..	265
Dover's Powder, 5 to 15 gr.	511
Dowzard Process	123
Doyen's Mycolysine	916
Dracunculus Medicinensis	491
Dragendorff's Test	43
Dragon's Blood..	794
Drainage Tubing	265
Dressings, Dental, 440; Sterilisation of, 439 & Steriloid, 438; Surgical, 436 <i>et seq.</i> ; Preparation of	439
Dreyer's Standard Method	547
Drigalski-Conradi Medium	425
Dridustsols	113
Dryopteris	420
Droitwich Brine Baths	441
Drop Measure Table	254
Dropwort	812
Drosera Rotundifolia	794
Drugs, Dangerous, Bill	951
" Narcotic, Order	953
Duboisia and Duboisine	210,	487
Ductless Glands. <i>See</i> Glands in question and 158
Dugong Oil, 595; Dulcitol	550, 551
Dum Dum Fever	492
Dunbar's Hay Fever Ser.	862
Dundas Grant's Inhalation Fluid	285
Dunham's Tassel 460 ; Solution 560
Duodenal Membrane Tabs. and Extract, 5 to 20 m.	914
" Ulcer 895 & Therap. Ind.
Duotal, 5 to 15 gr.	376
Duplitised Films X ray	288
Duralumin	136
Durant's Injection	375, 497
Duret's Calomel	79
Durine	125
Dusart's Syrup, 2 to 4 dr., 69; Wine	569
Dusting Powders, Lysoform (see also 136, 766)	128
Dutch Drops	648
Duty-free Alcohol	116, 122
Dyes, Aniline, 292; for foods.. (see also Individual Colors).	..	456
Dysentery, Serum (Bacilli, 483)	858, 977
" Vaccine, 50 to 2,000 mill.	859

NAME.	DOSE.	PAGE
Dysentery. Amœbæ, Search for	483
" Treatment (Emetine)..	513 <i>et seq.</i>
" Carriers	513 & 485
E.M.F., 270 ; Eade's Pills	569
Ear Cones, 218; Cocaine	323
Earth Nut Oil	780
Easton's Syrup (also Pills and Tablets, 418), ½ to 1 dr.	417
Eau de Botot	780
" de Cologne..	120
" de Goudron, 5-10 oz.	651
" de Javelle	50
" de Labarraque	50
" de Paris	120
" de Mellisse des Carmes	808
" Oxygénée	477
" Sedative	258
Ecballium Elaterium	795
Ecgonine	319 & 56
Echinacea, 794; Echinococcus..	..	378
Echitamine	778
Echium	795
Ecthol, 1 dr. well diluted	828
Eczema Marginatum .. Therap. Ind. &	508
Eczone Preps...	569
Edestin	441 & 464
Edington's Solution	381
Edmunds' Cell..	35, 118, 346

EFFERVESCENT SALTS.

(" gr." in drachm understood
—dose, 1 dr. or *q.s.*):

Acetanilide, 1 and 3 gr. ..	1
Ammon. Brom., 5 gr. ..	138
" Salicyl., 10 gr. ..	82
Antipyrine, 5, 10, 15 gr. ..	314
Caffeine (base), gr. 3 ..	245
" Citr. 2½ gr. c. Pot. ..	..
" Brom. 5 gr. ..	245
" HBr., 2½ gr. ..	245
Carlsbad Salt (Vesettes) ..	712
Catha Phenolphthalein, 1 to 2 dr. ..	272
Chloro-Sodio-Mag. Aper. ..	712
Glyceroph., 60 grs. ..	45
Iron & Quin. Citr., 3 gr. ..	665
Lecithin, 3 gr. ..	525
Lithium Citrate	528
" Hippuras, 5 gr. ..	528
" Salicyl, 2 gr. ..	528
Magnesium Citrate, 1-2 dr. or <i>q.s.</i> ..	..
" Sulphate, ½-1 oz. ..	532
Phenacetin, 5 and 10 gr. ..	312
" 5% et Caffeine, 2½% ..	312
Phenolphthalein, ½ to 2 dr. ..	635
Pilocarpine, ½ gr. ..	523
Piperazin, 5 gr. (et. c. Phenocoli) ..	650
Piperidine Tart., 5 gr. ..	650

FIGURES IN HEAVY TYPE *e.g.* 700, REFER TO VOL. II.

NAME.	DOSE.	PAGE.	NAME.	DOSE.	PAGE.
EFFERVESCENT SALTS—contd.			Elixir Aletridis, $\frac{1}{2}$ to 1 dr. . .		776
Potass. Citrate 1 or 2 dr.			„ Ammon. Brom., 1 to 2 dr. . .		138
Potassic Aperient, et c. Pot.			„ Anasarcin, 4 dr. . .		662
Sulphocarb.		662	„ Antim. Cinnam., 1-2 dr. . .		156
Quin. Citrate, 1 gr.		665	„ Antineuralg., 1-2 dr. . .		244
„ Salicyl, 3 gr.		672	„ Aperitive, $\frac{1}{2}$ to 1 dr. . .		132
„ Sulphate, 2 gr.		677	„ Aromat., $\frac{1}{2}$ to 2 dr. . .		392
Sal Bromatum		703	„ Arsamin ($\frac{1}{2}$ gr.), 1 dr. . .		184
Salicin, 5 gr.		93	„ Aurantii Amari, 2 to 4 dr. . .		393
Salicyl. Acid, 5 gr.		81	„ Bismuthi, 60 m.		227
Sodio-Mag. Aper. (et c. Caff-			„ Caffeinæ, 1 to 2 dr. . .		244
ein, 711)		711	„ Calc. Chlor., 1-2 dr. . .		253
Sodium Benzoate, 6 gr. in dr.		7	„ „ Iodidi, 1 dr.		254
„ Citro-Tart., 1 or 2 dr.			„ Camph., 30 to 60 m. . . .		258
Sodium Phosphate, 1 to 3 dr.		708	„ „ Monobr., 4 dr. . . .		260
„ Salicyl., 5, 10 grs. . . .		86	„ Cascara, 30-120 m. . . .		269
„ Sulphate, 1 dr. or more		711	„ Chloralamidi, 1 oz. . . .		278
Stront. Brom., 10 gr. . . .		720	„ Cinchonæ, 30 to 60 m. . .		290
Sulphonal 5 gr.		727	„ Cocæ, 1 to 4 dr.		318
Tylcalsin, 5 gr.		90	„ Cresoti, 1 to 2 dr. . . .		371
Tyllithin, 5 gr.		91	„ Curacao, 2 to 4 dr. . . .		393
Vesalvine, 5 gr.		446	„ Duodenalis, $\frac{1}{2}$ oz. . . .		914
Egg, Calorie Value		96	„ Ergotæ cum Ferro, 2 dr..		400
Egg Medium		559	„ Ferri Phosph., c, Quin et		
„ Yellow		456	„ Strych., $\frac{1}{2}$ to 1 dr. . .		418
„ Ehrlich Hata „		187	„ Ferro-Mang. Pept., 1 to		
Ehrlich's Hæmatoxylin . . .		390	„ 4 dr.		415
„ Indican Test		407	„ Ficorum, 1 to 4 dr. . . .		393
„ Sidic chains	833 et seq.		„ Formatum, Co., 1 to 2 dr.		39
„ Theory		255	„ Four Gland, 1 to 2 dr. . .		936
„ Urobilin Test		376	„ Gentian Ac., 1 to 2 gr. . .		798
Ehrlich-Biondi Stain		390	„ Glusidi, 5 to 20 m. . . .		685
Ehrlich-Blenden Eye-piece .		381	„ Glyceroph., 1 to 4 dr. . .		45
Ehrlitzki's Fluid		558	„ „ c. Format, 1-2 dr. . .		46
Ektantalum		313	„ Guaiaci, 1 to 2 dr. . . .		442
Ektogan		480	„ Hæmoglobin, 1 dr. or more		566
El Kossam		784	„ „ c. Lecithin, 1 to 2 dr.		566
Elæosacchara, P.G. (q.v.)			„ Heroin Pini, et Terpin,		
Elastica		264	„ 1 dr.		648
Elastic Hosiery		265	„ Ipecacuanhæ, 10 to 30 m.		511
Elaterinum, 1-40 to 1-10 gr.		795	„ Lecithin, 2 dr.		525
Elaterium, 1-10 to $\frac{1}{2}$ gr. . .		795	„ Lith. Hydrangea, 1 to 2 dr.		800
Elderberry Flowers		820	„ Manaca Salicyl, 1 to 2 dr.		807
Elecampane		802	„ Papain, 1 dr.		622
Electrargol		365	„ Paraldehyde, 1 to 3 dr. . .		123
Electrauro, 364; Electrocuprol		363	„ Paregoric, $\frac{1}{2}$ to 1 dr. . .		607
Electr. Hydrarg.		364	„ Pectorale, 1 dr.		433
Electro Palladiol		364	„ Pepsin, Bism. Strych., 1 dr.		632
„ Platinol		364	„ Pepticus, $\frac{1}{2}$ oz.		631
„ Selenium		364	„ Phosphori, 15-60 m. . . .		636
Electric Currents Injuries 1026 &		390	„ Pini et Terpin Sim., 1 dr.		648
Electricity, Medical 266 et seq;			„ Pini Terpin et Heroin, 1 dr.		648
static		301	„ Quinque Brom., 1 dr. . .		658
Electrolytes	267,	272	„ Rhei, 1 to 3 dr.		393
Electromotive Force		270	„ Rubrum, 20-60 m. . . .		393
Electuaire Diascord, 15 gr.		828	„ Saccharini, 5 to 20 m. . .		685
Elements, Table of Vol. II., xxx.			„ Secretogen, 1 to 2 dr. . .		914
Elephantiasis, see Filariasis			„ Sennæ (et Legum.), 1 to		
Therap. Ind. &		486	„ 3 dr.		693
Elettaria Cardam		786	„ Simplex, 20-60 m. . . .		392
Elixirs		392	„ Sodii Brom-aceto salicy-		
Elixir Acetanilid. Co., $\frac{1}{2}$ to 1 dr.		1	„ lat., $\frac{1}{2}$ oz. rep.		88
„ Acidi Salicyl. Co., 1 dr. . .		79	„ Sodii Cacodyl., 30 m. . .		182
„ Agrimonæ, Co., 1 dr. . . .		776	„ „ Formatis, 2 dr. . . .		39

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE.
ELIXIRS—contd.			Emuls. Lecithin, $\frac{1}{2}$ oz. . .	..	525
Elixir Symphyti, $\frac{1}{2}$ to 2 dr. . .	826		, Ol. Chaumoogræ $\frac{1}{2}$ to		
, Three Gland, 1 to 2 dr. . .	936		1 dr. . .	..	588
, Thymiet Diaphorm, 1 dr. . .	828		, Olei Papaveris, $\frac{1}{2}$ to 1 oz. . .	597	
, Vesalvine 'S', 1 dr. . .	447		, Olei Gynocardii $\frac{1}{2}$ to 1 dr. . .	588	
, Vitæ, 20 m. . .	808		, , Morrhuae 2 to 8 dr. . .	594	
, Vanillin Co., $\frac{1}{2}$ to 1 dr. . .	829		, , Ferrat, 2 to 8 dr. . .	594	
, Viburn Prunif. (& Co.) . .	830		, , c. Lecithin, 2 to 8 dr. . .	594	
, of Vitriol, 5-20 m. . .	97		, , Morrhuae et Glyceroph		
Elixoid Mucin, 1 to 4 dr. . .	916		2 to 8 dr. . .	..	46
Elschnig's Medium . . .	561		, Morrhuae et Hypoph.,		
Elm, 829; Embalming Solutions	561		2 to 8 dr. . .	594	
Embalment of Wounds . .	494		, Morrh. et Iodoform, 2 to		
<i>Embelia</i> , 1 to 4 dr. . .	795		8 dr. . .	..	595
Emblie Myrobalans, 1 or 2 . .	795		, , cum Quinina . .	667	
Emery's Wassermann Reac-			, Olivæ, 1 to 2 oz. . .	596	
tion . . .	523		, Ol. Papaveris, $\frac{1}{2}$ to 1 oz. . .	597	
Emetamine . . .	519		, Paraff. c. Bismuth, 1 oz. . .	626	
Emetina (Alk.) . . .	512, 149		, c. Pancreatin, 2 to 4 dr. . .	625	
, Adsorption Products . .	520, 86		, c. Rhamno Frang, $\frac{1}{2}$ to		
, HBr. Hyp., $\frac{1}{2}$ to $\frac{3}{4}$ gr. . .	516		1 oz. . .	..	26
, HCl. Expt., $\frac{1}{160}$ to $\frac{1}{16}$ gr. . .	512		, Petrol. c. Hypoph., 1 to		
, , Hyp., $\frac{1}{2}$ to $\frac{3}{4}$ gr. . .			4 dr. . .	..	625
Emetin (Extractive) Expt.			Salol, $\frac{1}{2}$ to 1 oz. . .	..	94
$\frac{1}{16}$ to $\frac{1}{10}$, Emetic, $\frac{1}{2}$ to 1 gr. . .	519		, Santonini. . .	..	688
Emetine Bismuth Iodide, 1 to			, Seminum Cannabis . .	786	
3 gr. . .	516, 86		, Sesami, 2 to 3 oz. p.d. . .	604	
Emetique, Max. single, 3 gr. . .	156		, Sulphuris. . .	728, 872	
Emodin . . .	692, 797 & 49, 148		, Terebinth, 1 dr. . .	647	
Emol Keleet . . .	136		Endocarditis Scrum . .	874	
Empirin, 5 to 15 gr. . .	86		Endolytic Tubes . .	363, 372, 400	
Emplast. Ac. Salicyl Sap. . .	80		Endo's Medium. . .	552	
, <i>Adhesivum</i> . . .	584		Enemata . . .	393	
, , Ang. . .	802		Enema, Acid Salicyl, 0.3% . .	395	
, Allii . . .	777		, Alum, 0.5% . .	395	
, <i>Belladonnæ</i> , 222; U.S. . .	222		, Ammonia . . .	141	
, , Extensum . . .	222		, Aperiens . . .	394	
, , Liq. . .	221		, Argent. Nit. 0.1% . .	395	
, <i>Calefaciens</i> . . .	262		, Asafoetida, 5% . .	395, 781	
, <i>Cantharidini</i> . . .	262		, Bismuth Carb. or Subnit.,		
, <i>Cantharidis</i> Liq. . .	263		1% . .	395	
, <i>Capsici</i> (various) . .	266, 267		, , Sod. Salicyl., 1 pint. . .	234	
, <i>Cocainæ</i> . . .	320		, Boric Acid. Sat. Sol. . .	395	
, <i>Cupri Oleatis</i> . . .	583		, Chloral, 4 oz. . .	277	
, <i>Diachylon</i> . . .	584		, Cresol (preparations), 0.5		
, <i>Hydrarg. Stearatis</i> . .	584		to 1% . .	395	
, <i>Menthol</i> . . .	540		, Dextrose . . .	394	
, <i>Methyl Salicyl.</i> . .	81		, Evacuans. . .	395	
, <i>Mouche de Milan</i> (Em-			, Ferri Chloridi (Liq.), 2% . .	395	
plâtre) . . .	262		, Glycerin, $\frac{1}{2}$ oz. . .	394	
, <i>Opii</i> , 606; <i>Picis</i> . .	651		, Hyd. Perchlor., 0.01 to		
, <i>Plumbi</i> . . .	584		0.05% . .	395	
, <i>Resinæ</i> . . .	584		, Inf. Allii . . .	395	
, <i>Saponis</i> . . .	584		, Mag. Sulph., $\frac{1}{2}$ to 2 oz. . .	532	
, <i>Thapsiæ</i> . . .	828		, Mucilaginis, 25% . .	395	
, <i>Vesicans</i> . . .	263		, Nutriens, 394; (Dextrose)	394	
Emblastra for Tropics . .	770		, Olei Ricini, 5 to 10 ozs. . .	599	
Emulsin . . .	144 & 69		, , Terebinth., 0.5 to 1% . .	395, 647	
Emuls. Amygdalæ, av. 4 oz. . .	145		, Oleosum . . .	596	
, Asafoetida, 4 dr. . .	781		, <i>Opii</i> . . .	395	
, Benzyl Benz., $\frac{1}{2}$ to 2 dr. . .	303		, <i>Plumbi</i> Acet. 1% . .	395	
, Bismuthi et Paraffini, 1 oz. . .	626		, Silver Gelatose . .	172	
, Bromoform, 2 to 4 dr. . .	240		, Simplex . . .	394	
, Iodinol, 2 dr. . .	499				
, Iodoformi . . .	492				

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Enema Sodii Chloridi	702	Esbach's Picric Solution	371
„ Stimulant, for Thirst, etc.	..	394	Escherich's Test ..	..	897, 898
„ Tannin, 1%	395	Eserina, $\frac{1}{10}$ to $\frac{1}{5}$ gr. ..	..	641
Enesol (injected), 1 gr. in 30 m.	..	179	Eserinæ., Salicyl., 641; <i>Sulph.</i> ,	..	642
Enfleurance	112	1/60 to 1/20 gr. ..	..	642
'English Disease'	103	Esprit <i>var.</i> vide Spiritus ..	..	—
Eno's Fruit Salt	569	„ Ammonia. Anisat ..	..	433
Ens Melissa	808	Esparto ..	..	796
Entada Scandens	795	Espundia ..	..	492
Entamoeba Cysts, Search for..	..	514 & 483	Essence of Beef ..	..	564
„ Buccalis	872	Essence of Ginger, 769; Vanilla ..	..	829
„ Coli	483, 484	„ „ Rennet ..	..	630
„ histolytica 513 <i>et seq.</i> &	..	483	Essentia Anisi, '85, 10 to 20 m.;	..	—
„ Nana	484	Menth. Pip., '85, 10 to 20 m.;	..	—
Enteric Fever. <i>See</i> Typhoid.	..	—	Yerba Buena (Ph. Notes)=	..	—
Enterococcus	530	Mentha Sativa ..	..	—
Enzyme Action	533, 631	Essential Oils 112, as Antiseptics	..	581 & 114
„ Artificial	348	„ „ Terpeneless ..	..	112
„ Table of	69	Ether, 106; (Mendeléeff) Vol. II., xxx.	..	—
Enzymol	634	„ Chloric ..	..	286
Enzvtol, 3 to 20 Cc. dil.	5	„ Green ..	..	278
Eosin and Selenium in Cancer	..	731	„ Methylenique et Diméthyl-	..	—
„ Stains (various)	556	lique de l'Allyl-apionol	..	163
Eosins (note)	386	Ozonie ..	..	479
Eosote, 4 to 12 gr.	374	„ Perles 3 m. in each ..	..	111
Ephedrine	795, 149	„ Soap, <i>et c.</i> Merc. Iodide 690, 691	..	—
Epinephrin ..	926 & Assay	152	„ with Atropine ..	..	109
Epinene	931	„ with Olive Oil ..	..	110
Epsom Salts (Mag. Sulph.)	531	„ with Oxygen and Alcohol	..	107
Equisetum Arvense	795	„ with Oxygen and Gas ..	..	108
Erasmus Wilson's Lotion	142	„ with Paraff. Liq. Oraluse	..	110
Erdmann's Test	174	„ with Saline ..	..	109
Erepsin	69	„ <i>v.</i> also Æther.	..	—
Ergamine	399	Ethocaine HCl., 1/5 to 1 gr. ..	..	332
Ergoapiol	163	Ethoxydichloroarsine ..	..	458
Ergot, 15 to 60 gr.	395 & 70	Ethyl Acetate ..	..	112
Ergot Aseptic	396	„ Alcohol ..	..	115, 18
„ of Maize	807	„ Amido-benzoate ..	..	334
„ Physiol, Standardised	..	396 & 159	„ Bromide (Caps. 5 m.) ..	..	775
Ergotin, 2 to 8 gr.	397	„ Butyrate ..	..	23
Ergotinine Cristallisée, 1/200 to	..	—	„ Carbamate, 10 to 60 gr. ...	..	759
1/64 gr.	398	„ Chloridum ..	..	112
„ Cit., 1/150 to 1/30 gr.	..	398	„ „ and Nitrous Oxide ..	..	113
Ergotoxine, 1/100-1/50 gr.	398	„ „ Inhaler ..	..	113
Ergoval, 10 to 30 m. or 60 m.	..	396	„ „ Medictd. Solns. ..	..	113
Eriodictyon	831	„ „ Group effect of ..	..	258
Erica, Ericolin	542	„ Hydro Cupreine HCl., 8 gr.	..	378, 379
Erigeron Can.	795	„ Iodide ..	..	114 & 354
Ernutin, 30 to 60 m.	398	„ „ Sterules, 5 m. ..	..	114
Erodium	796	„ „ c. Chlorof. Sterules ..	..	115
Erucae Semina (Sinapis)	694	„ Morphine (Base) ..	..	548
Erysipelas Dressing, 767; Serum	..	874	„ „ HCl., $\frac{1}{4}$ to $\frac{1}{2}$ gr. ..	..	547
Erysimum	796	„ „ Sulphate ..	..	124
Erythro-Selenium	364	„ Mydriatine ..	..	148
Erythrol Nitrate, $\frac{1}{2}$ to 1 gr. incr.	..	401	„ Nitrite Sol., 15 to 60 m.	..	112
Erythrophlœinæ Sulph., 1/40 to	..	—	„ Oxide, 106; Salicyl ..	..	81
1/24 gr.	403	„ Phenyl Cinchoninate ..	..	650
Erythrosins	386	Ethylene Bromide, 1 to 2 m. ...	..	775
Erythrotetranitral, $\frac{1}{2}$ to gr. incr.	..	401	„ -diamine ..	..	169
Erythroxyllum Coca, 30 to 120	..	—	„ -diamine-silver Phosph.	..	169
gr.	317	„ Dichlor.	287
Esanofele	678	Ethyl Nitrite Solution	112

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NAME.	DOSE.	PAGE
Eucaine HCl. B, 1/10- $\frac{1}{2}$ gr. . .		329
„ Ionised		276
„ Lact. B, $\frac{1}{8}$ to $\frac{1}{2}$ gr. . .		331
Eucaine c. Adrenalin		330
„ Capsules and Powders . .		330
Eucalypti Folia, 5 gr. . . .		403
„ Gummi, 2-5 gr.		796
Eucalyptol, 1 to 4 m. . . .		405 & 71
„ Arsenate		149
„ Chlorinated		63
„ Phosphate, 1 to 5 gr. . .		405
Eucerin, 750; Euchinin . . .		679
Euchlorine Gargle		705
Eucodeine, $\frac{3}{4}$ gr.		341
Eugallol		78
Eugenol	403, 787, 796, 815,	151
Eumenthol Jujubes		406
Eumydrine		217
Eunatrol		689
<i>Euonymi Cortex</i>		406
<i>Euonymin</i> , 1 to 2 gr. . . .		406
Eupad		55
Eupatorium		796
Euphorbia Pil, 797; Peplus .		796
Euphorine, 3 to 6 gr. . . .		759
Euphyllin, 6 gr. (injected) .		738
Eupnine, 1 dr.		246
Euquinine, 3 to 15 gr. . . .		679
Euresol, 683; Eurobin . . .		289
Eusemine		930
Eusol		51
„ Assay		51
„ Bactericidal Power . . .		52, 354
„ Intravenous Use		53
„ Uses 52; Cordova's Modif. .		55
Eustachian Self-Inflator . .		285
Eustenine, 8 to 15 gr. . . .		737
Evatmine		928
Evonymine		406
Ewald's Breakfast		460
Exalgine, $\frac{1}{2}$ to 2 gr.		2
Excise Duty		116
Exhaust Gas, Poisoning by . .		130
Exogonium, 523; Exol		744
Eye Douches		265
Eye Operation Set		439

Extracta :*(vide also Fluidextr).*

„ Acocantheræ Liq. max. . .		
4 m (?)		773
„ Aconiti Rad. Alc., max. . .		
$\frac{1}{2}$ gr.		102
„ Agarici, $\frac{1}{2}$ to 2 gr.		776
„ <i>Agropyri Liq.</i> , 1 to 2 dr. . .		776
„ Aletridis, Liq., 5 to 15 m. .		776
„ Allii, 4 to 10 gr.		777
„ Alni Glutinosæ Liq., 10 to . .		
30 m.		778
„ Aloes, 1 to 4 gr.		131 & 24
„ „ Barb. and Soc.		131 & 24
„ Anthemidis, 2 to 8 gr. . . .		780
„ Apocyni Liq., 15 m.		164
„ Belæ Liq., 1 to 2 dr.		784

NAME.	DOSE.	PAGE
Extracta :		
„ <i>Bellad. Sicc.</i> , $\frac{1}{4}$ -1 gr. . . .		222, 42
„ Bellad Fol., av. $\frac{1}{4}$ gr. . . .		222, 42
„ „ <i>Liq.</i> , $\frac{1}{8}$ -1 m.		222
„ „ Viride, $\frac{1}{4}$ to 1 gr. . . .		222, 42
„ Bone Marrow, 1-2 dr. . . .		912
„ Brain, 5 to 10 m.		912
„ „ Fresh, 2 to 4 dr.		913
„ Buchu Liq. 30 m.		241
„ Bynes (and Liq.), 1 to 4 . .		
dr.		532, 533
„ Cacti Grandi. Liq., 1 to . .		
10 m.		788
„ Calumbæ, '85, 2-10 gr. . . .		—
„ <i>Cannabis Ind.</i> $\frac{1}{4}$ -1 gr. . . .		261
„ „ Liq., $1\frac{1}{2}$ m.		261
„ Capsici Liq., 1 m.		267
„ Carnis		563
„ <i>Cascaræ Sag.</i> , 2 to 8 gr. . .		269
„ <i>Cascaræ Sagradæ Liq.</i> , 30 . .		
to 60 m.		269
„ Cascaræ Aromat. Liq., 30 . .		
to 60 m.		270
„ Cassiæ Bear. Liq., 30 to . .		
60 m.		787
„ Catha Sold., $2\frac{1}{2}$ to 10 gr. . .		272
„ „ Liq., 1 to 5 m.		272
„ Caulophylli Liq., 8 m. . . .		788
„ Cerebri Liq., 5-10 m. . . .		912
„ „ Recent, 2 to 4 dr. . . .		913
„ Cerevis. Ferment. 3 gr. . . .		274
„ Chekan. Liq., $\frac{1}{2}$ -3 dr. . . .		789
„ Chelid Liq., 10 to 30 m. . .		790
„ Chenopodii Liq., $\frac{1}{2}$ to 1 dr. .		790
„ Chinæ, 1 to 4 gr.		290
„ Chiratæ Liq., 15 m.		790
„ Cigue, $\frac{3}{4}$ gr.		368
„ Cimicifugæ Liq., 5-30 m. . .		790
„ <i>Cinchonæ Liq.</i> , 5-15 m. . . .		290 &
		51
„ Cocæ, 2 to 15 gr.		318
„ „ Liq., $\frac{1}{2}$ -1 dr.		318
„ <i>Colchici</i> , $\frac{1}{4}$ to 1 gr.		342
„ Collinson. Liq., $\frac{1}{2}$ to 2 dr. . .		791
„ Colocynth., av. $\frac{1}{4}$ gr. . . .		367
„ <i>Colocynth. Comp.</i> , 2 to 8 . .		
gr.		367
„ Condurango Liq., 10 to . .		
60 m.		791
„ Conii, max. $\frac{3}{4}$ gr. FR. CX. . .		368
„ „ Liq., 5 to 15 m.		368
„ Convallariæ, 2-8 gr.		792
„ Corn Silk, Liq. 1 dr.		807
„ Coto Liq., 2 to 6 m.		369
„ Cyperi Rot. Liq., 15 to . .		
60 m.		794
„ Damianæ, 2 to 10 gr.; . . .		
Liq., $\frac{1}{2}$ to 1 dr.		383
„ Digitalis, FR. CX. (U.S., . .		
av., $\frac{1}{4}$ gr.)		387
„ d'Orges		532
„ Dulcamara		823
„ Duodenal Liq., 5 to 20 m. .		914

FIGURES IN HEAVY TYPE, e.g. 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Ext. <i>Ergotæ</i> , 2 to 8 gr. . .		397	Ext. <i>Kavæ</i> , 5 to 10 gr. . .		804
„ „ <i>Liq.</i> , 10-30 m. . .		396	„ „ <i>Liq.</i> , 30 to 60 m. . .		804
„ „ <i>Phys. Stand.</i> . .		396	„ <i>Kolæ Liq.</i> , 10-20 m. . .		247
„ <i>Erigeron Liq.</i> , 30-60 m. . .		795	„ <i>Kramerizæ</i> , 5-15 gr.; <i>Liq.</i>		
„ <i>Erodii Liq.</i> , 15 m. . .		796	15 m. . .		804
„ <i>Erythroxyli Liq.</i> , $\frac{1}{2}$ -1 dr. . .		318	„ <i>Lactucæ</i> , '85, 5-15 gr. . .		
„ <i>Eucalypti Gum. Liq.</i> , 30			„ <i>Lasiosiphon Liq.</i> , 2 to 5 m. . .		805
to 60 m. . .		796	„ <i>Leptandræ</i> , av. 4 gr. . .		805
„ <i>Euonymi</i> 1 to 2 gr. . .		406	„ <i>Lupuli</i> , 2 to 6 gr. . .		806
„ „ <i>Liq.</i> , 10 60 m. . .		407	„ „ <i>Liq.</i> , 5 to 15 m. . .		
„ <i>Eupatorii Liq.</i> , 30 m. . .		796	„ <i>Maidis Stig. Liq.</i> , 1 dr. . .		807
<i>Euphorbiæ Pepli</i> , 7 $\frac{1}{2}$ to			„ „ <i>Ustil. Liq.</i> , $\frac{1}{2}$ to 2 dr. . .		807
30 gr. . .		797	„ <i>Malti (& Liq.)</i> , 1 to 4 dr. . .		
<i>Euphorbiæ Pil.</i> , $\frac{1}{2}$ to 1 $\frac{1}{2}$ gr. . .		797		533 & 90	
„ <i>Eye</i> , 2 dr. . .		914	„ „ <i>Ferratum</i> . .		534
„ <i>Fæxin</i> , 3 gr. . .		274	„ „ c. <i>Cascara</i> . .		534
„ <i>Ferri Pomatum</i> . .		415	„ „ c. <i>Hæmoglobin</i> . .		534
„ <i>Filicis Liq.</i> 45-90 m. . .	420, 74		„ „ c. <i>Hypophos.</i> . .		534
„ <i>Frangulæ Liq.</i> , 1-4 dr. . .		797	„ „ c. „ c. <i>Ol. Morr-</i>		
„ <i>Fuci Vesic.</i> , 3 to 10 gr. . .		797	huæ . .		534
„ „ <i>Liq.</i> , 1 to 2 dr. . .		797	„ „ c. <i>Glyceroph.</i> . .		45
„ <i>Fungi Secalis Liq.</i> . .		396	„ „ c. <i>Iodinol</i> (1 oz.		
„ <i>Galii</i> , 5 to 20 gr. . .		798	dose) . .		499
„ <i>Gelsem. Pulv.</i> , $\frac{1}{2}$ -2 gr. . .		424	„ „ c. <i>Oleo Morrhuæ</i> . .		534
„ <i>Gentianæ</i> , 2 to 8 gr. . .		798	„ „ c. <i>Pancreatin</i> . .		534
„ <i>Glaucii Liq.</i> , 1 dr. . .		799	„ <i>Malti Sicc.</i> , 1 to 2 dr. . .		535
„ <i>Glycyrrhizæ</i> , 5-60 gr. . .	432, 433		„ „ c. <i>Syr. Ferri Phosph.</i> ,		
„ „ <i>Liq.</i> , 30-60 m. . .		433	1 to 4 dr. . .		534
„ <i>Gokhru Liq.</i> , 20-60 m. . .		799	„ „ <i>Paraff.</i> . .		535
„ <i>Gossypii</i> , 1 to 4 gr. . .		441	„ <i>Manaca Liq.</i> , 10-30 m. . .		807
„ „ <i>Liq.</i> , $\frac{1}{2}$ to 1 dr. . .		441	„ <i>Meat</i> . .		563
„ „ <i>Sem.</i> , 1 dr. . .		441	„ <i>Menyanthis Liq.</i> , $\frac{1}{2}$ oz. . .		809
„ <i>Granati Liq.</i> , 30 m. . .		629	„ <i>Mezereon Liq.</i> . .		809
„ <i>Grindeliæ</i> , 2 to 3 gr. . .		441	„ <i>Monsoniæ Liq.</i> , 10 to 30 m. . .		809
„ „ <i>Liq.</i> , 10 to 20 m. . .		441	„ <i>Muiria Puania</i> . .		810
„ „ <i>Co.</i> , 1 dr. . .		442	„ <i>Myrtilli Liq.</i> 2 ozs. p.d. . .		811
„ <i>Hæmatoxyli Liq. (& Solid,</i>			„ <i>Nucis Vom.</i> , $\frac{1}{2}$ to 1 gr. . .		580
av. 15 gr.), $\frac{1}{2}$ to 2 dr. . .		799	„ „ „ <i>Liq.</i> , 1 to 3 m. . .	580 &	
„ <i>Hæmostatic</i> . .		397		112	
„ <i>Hamamelidis Dest.</i> , $\frac{1}{2}$ to			„ <i>Opii Siccum</i> (20% <i>Morph.</i>),		
3 dr. . .		443	$\frac{1}{4}$ to 1 gr. . .		606
„ „ <i>Liq.</i> , 5-15 m. . .			„ „ <i>Liq.</i> (0.75% <i>Morph.</i>),		
„ <i>Heart (as Test)</i> . .		517	5 to 30 m. . .		606
„ <i>Hippocast Liq.</i> . .		774	„ <i>Papaveris</i> , '85, 2 to 5 gr. . .		
„ <i>Holarrhenæ Liq.</i> . .		800	„ <i>Pareiræ Liq.</i> , 30 to 120 m. . .		813
„ <i>Humuli</i> , 2 to 6 gr. . .		803	„ <i>Physostigmat.</i> , $\frac{1}{4}$ to 1 gr. . .		641
„ <i>Hydrastis</i> , 2 to 5 gr. . .		475	„ <i>Pichi Liq.</i> , 10 to 60 m. . .		814
„ „ <i>Liq.</i> , 5-15 m. . .		475	„ <i>Picorrhizæ Liq.</i> , 15 to 60 m. . .		815
„ <i>Hypophysis</i> , $\frac{1}{2}$ to 1 Ce. . .		919	„ <i>Pini Canad. Liq.</i> , 10 to 60 m. . .		815
„ <i>Hysterioniciæ Liq.</i> , 5 to 15			„ „ <i>Sylvestris</i> . .		648
m. . .		802	„ <i>Piscidiæ</i> , 2 to 5 gr.; <i>Liq.</i>		
„ <i>Hyoscy.</i> , 2 to 8 gr. . .		486	20 to 120 m. . .		816
„ „ <i>Viride</i> , 2-8 gr. . .		486	„ <i>Pituitary Gland</i> , $\frac{1}{2}$ to 1 Ce. . .		919
„ <i>Infundibular</i> , $\frac{1}{2}$ to 1 Ce. . .		919	„ <i>Pluriglandular</i> , 1 Ce. hyp. . .		936
„ <i>Inulæ Liq.</i> , 10-60 m. . .		802	„ <i>Pulsatilla Liq.</i> , 2 to 5 m. . .		817
„ <i>Ipecac.</i> . .		511	„ <i>Quassia</i> , 3 to 5 gr., <i>Liq.</i> . .		818
„ <i>Ipecac.</i> { <i>Expectorant</i> }			„ <i>Quebracho Liq.</i> , 5 to 10 m. . .		818
„ <i>Liq.</i> { $\frac{1}{2}$ to 2 m. . .	511,		„ <i>Quillaia</i> . .		818
{ <i>Emetic</i> , 15 . .	86		„ <i>Red Bone Marrow</i> , 1 to 2 dr. . .		912
{ to 20 m. ('98) }			„ <i>Renal</i> . .		915
„ <i>Iridis</i> . .		802	„ <i>Retinale</i> , 2 dr. . .		914
„ <i>Jaborandi</i> , 2 to 10 gr.,			„ <i>Rhamni Frang.</i> , 15 to 60		
(B.P. '85) . .			gr.; <i>Liq.</i> , 1 to 4 dr. . .		797
„ „ <i>Liq.</i> , 5 to 15 m. . .		521	„ „ <i>Pursh.</i> , av. 4 gr. . .		269
„ <i>Jalapæ</i> , 2 to 8 gr. . .		523	„ „ „ <i>Fluid.</i> . .		269

FIGURES IN HEAVY TYPE, e.g. **100**, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Ext. <i>Rhei</i> , 2 to 8 gr.		683	Fæxin, Extr. Pills, 3 gr.		274
„ <i>Rhois Aromat. Liq.</i> , 10 to 30 m., 819; <i>Glabræ Liq.</i> , av. 15 m.		819	„ Extr. Tablets, 3 gr.		274
„ <i>Rice Polishings</i>		578 & 468	Farrant's Mtg. Medium		558
„ <i>Rubi Chamæmori Liq.</i> , $\frac{1}{2}$ to 1 dr.		819	Farris Water		437
„ <i>Salicis Nig. Liq.</i> , $\frac{1}{4}$ to 1 dr.		820	Fasting		105
„ „ <i>Solid</i> , 1 to 5 gr.		820	Fats, 581, 94 Iodine, No. of 85 , Melting Points		252
„ <i>Sanguinariæ, Liq.</i> , $1\frac{1}{2}$ m.		820	Saponificn Figs.		143
„ <i>Sansivieræ</i> , 10-20 gr.; <i>Liq.</i> , 2 to 4 dr.		821	Favus, 508 ; Feculose		733
„ <i>Sarsæ Liq.</i> , 2 to 4 dr.		691	<i>Fehling's Solution</i> , Modifications and Interference of other substances than Glucose		399
„ <i>Saw Palmetto</i> , 3-5 gr.; <i>Liq.</i> , $\frac{1}{2}$ to 2 dr.		821	<i>Fel Bovinum Purif.</i> , 5-15 gr.		407
„ <i>Scillæ</i>		821	„ Exsicc., 5 to 10 gr.		407
„ <i>Scutellaria Liq.</i> , 5 to 15 m.		822	Fellows' Syrup of Hypophosphites, medium adult, 1 dr.		639 & 570
„ <i>Secretin</i> , 5 to 20 m.		914	Felt, 437; <i>Fennel</i>		797
„ <i>Senecio. Liq.</i> , 20-60 m.		822	Fenning's Cooling Powders		570
„ <i>Sennæ Leg. Liq.</i> , 1-3 dr.		693	Fer Ascoli, 820; <i>Fermenlactyl</i>		69
„ <i>Serpentar Liq.</i> , 5 to 15 m.		823	Fermentation Test		401
„ <i>Solani Tub. Liq.</i> , 1 to 4 dr.		824	Ferments, Metallic, 348; <i>see</i> also Enzymes, Diastase, Pepsin, etc.		
„ <i>Sorbi Liq.</i> , 10 to 30 m.		824	Ferri Aceto-Salicyl.		11
„ <i>Spinal Cord</i> , 5-20 m.		913	„ <i>Alginas</i> , 2 to 15 gr.		776
„ <i>Stramonii</i> , $\frac{1}{4}$ to 1 gr.		719	„ <i>Arsenas</i> , $1/16$ to $\frac{1}{4}$ gr.		178
„ <i>Strophanthi</i> , $\frac{1}{4}$ -1 gr.		722	„ <i>Cacodylas</i> , $\frac{3}{4}$ to 5 gr.		181
„ <i>Strychni</i> , $\frac{1}{4}$ to 1 gr.		580	„ <i>Carb. Sacch.</i> , 10-30 gr.		408
„ <i>Sumbul Liq. U.S.</i> , av. 30 m.		826	„ Conc.		408
„ <i>Supra-renal Liq.</i> 10 to 15 m.		925	„ Chlorid., U.S. = Ferri Perchlor.		409
„ „ <i>Sicc.</i> , $\frac{1}{2}$ to 3 gr.		924	„ Citras, U.S., av. 4 gr.		408
„ <i>Symphiti</i> , 5 to 10 gr.		826	„ <i>et Ammon. Cit.</i> , 5 to 10 gr.		409
„ „ <i>Liq.</i> 2 to 4 dr.		826	„ „ <i>Virid.</i> , 5 to 10 gr.		409 & 73
„ <i>Tanaceti Liq.</i> , 15-30 m.		827	„ „ <i>Sulph.</i> , 3 to 10 gr.		419
„ <i>Taraxaci</i> , 5 to 15 gr.		827	„ <i>Tart.</i> , U.S., 4 gr.		420
„ „ <i>Liq.</i> , $\frac{1}{2}$ to 2 dr.		827	„ <i>et Mag. Sulph.</i> , 2 to 10 gr.		419
„ <i>Tebaiaco</i> , $\frac{1}{4}$ to 1 gr.		606	„ <i>Mang. Citras</i> , 3 to 15 gr.		419
„ <i>Thymi Liq.</i> , 5 to 30 m.		828	„ <i>Potass. Tart.</i> , 5 to 10 gr.		420
„ <i>Thymus Gland</i> , $\frac{1}{2}$ -2 dr.		933	„ <i>Quin. Citras</i> , 5-10 gr.		665
„ <i>Thyroid = Thyroid Sicc.</i> , 935; <i>Liq. Thyroid</i>		934 & 154	„ „ <i>Eff.</i> , 3 grs.		665
„ <i>Tritici Liq.</i> , 1-2 dr.		776	„ <i>Quin. et Strych. Cit.</i> 3 to 6 gr.		723
„ <i>Uvæ Ursi Liq.</i> , 20 to 40 m.		781	„ <i>Strych. Cit.</i> , 2 gr.		723
„ <i>Valerianæ (Liq., 30 m.)</i> , 1 to 5 gr.		760	„ <i>Fluoridum</i> , $\frac{1}{20}$ to $\frac{1}{2}$ gr.		773
„ <i>Viburni Prunif.</i> , 2 to 10 gr., <i>Liq.</i> , 60 to 120 m.		830	„ <i>Formas</i> , $1\frac{1}{2}$ to 3 gr.		39
„ <i>Vincæ Majoris Liq.</i> , 1 to 2 dr.		830	„ <i>Glyceroph.</i> , 1 to 5 gr.		42
„ <i>Violæ Liq.</i> , 1 dr.		830	„ <i>Hydrox.</i>		349
„ <i>Yeast</i>		273, 97	„ „ <i>c. Mag. Ox.</i>		174, 409
„ <i>Yerbæ Santæ</i> , 10 to 40 m.		831	„ <i>Hypophosph.</i> , 1-5 gr.		638
Extracts <i>Liq. Spirit Strength for Tropics</i>		770	„ <i>Iodidum</i> , 1 to 5 gr.		415
Eye Bottles, 214; <i>Douches</i> , 265; <i>Extract</i> , 914; <i>Lotion Cocaine (Factory)</i> , 320; <i>Lotion Isotonic</i> , 324; <i>Operation Sets</i> , 439; <i>Pads</i> , 437; <i>Rods</i>		214	„ <i>Iodid. Sacch.</i> , 2-15 gr.		416
Fæces Exam. of		396	„ <i>Lactas</i> , 1 to 5 gr.		68
„ <i>T.B. in</i>		541	„ <i>Lactoph. et Calcii (Syrup)</i>		69
Fæx Medicinalis, $\frac{1}{2}$ to 1 oz.		273	„ <i>Nucleinas</i> , 15 gr.		412
Fæxin, 1 dr.		273	„ <i>Oleas</i> , 5 to 15 gr.		586
			„ <i>Oxalas</i> , 1 to 5 gr.		416
			„ <i>Oxydat. Sacch.</i> , 10 to 40 gr.		411
			„ <i>Oxypersulphas (Monsel's)</i>		419
			„ <i>Para-amino-benz-sulphonate</i>		413

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NAME.	DOSE.	PAGE
Ferri Peptonat, 412; Liq., 1-4 dr.	412
, Perchlor. (wool, 410), 2-8 gr.	409
„ <i>Phosphas Saccharatus</i> , 5 to 10 gr.	416
„ <i>Solubilis</i> , 4 gr.	416
Pyrophosph., U.S., 4 gr.	417
„ <i>Salicylas</i> , 3 to 10 gr.	82
„ <i>Sesquichlor</i>	409
„ <i>Subsulph.</i>	419
„ <i>Succinas</i>	96
„ <i>Sulphanilas</i>	413
„ <i>Sulphas</i> (Granulat., U.S.), 1 to 5 gr.	419 &	357
„ „ <i>Exsicc.</i> , $\frac{1}{2}$ to 3 gr.	419
„ <i>Valerianas</i> , 3 to 15 gr.	761
Ferrier's Snuff	234
Ferrinol, 15 gr.	412
Ferrivine	413, 73
Ferripyrin	315
Ferro-Alumen, 3 to 10 gr.	419
Ferrocarnis, 1 dr.	564
Ferrocyanic Test Pellets	370
Ferroglydine Tabs.	576
Ferro Mang. Phosph., 3 to 10 gr.	535
Ferropyrin, 3 to 8 gr.	315
Ferro-sajodin Tabs., $7\frac{1}{2}$ gr.	508
Ferro-Silicon	73
<i>Ferrum</i>	408 & 72
„ <i>Oxydat. Sacch.</i> , 10 to 40 gr.	411
„ <i>Redactum</i> , 1 to 5 gr.	408
„ <i>Tartaratum</i> , 5 to 10 gr.	420
Fett-Ponceau R.	304
Fever, see Diseases in question, also Table, p. 940.		
Fibrin 367 ; Ferment.	69
Fibro-coumarin Sterules, 25 m.	30
Fibrolysan	694
Fibrolysin, 1 to 2 Cc.	694
Ficus Carica	797
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Filaria .. Therap. Ind. &	486
Filicin	420 & 74
<i>Filix Mas</i>	420, 74
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„ „ Syph. Test	517
„ „ Tinct. Aconite, 1 to 5 m.	103

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Flour Standardisation etc.	100
„ Bleaching	100 , 100
„ Faking	100
„ Milling	100
Fluid Magnesia, 1-2 ozs.	521
Fluidextr. Aconiti, av. $\frac{1}{2}$ m.	103
„ Apocyni, 15 m.	161
„ Bellad., Rad., $\frac{1}{3}$ to 1 m.	222
„ Buchu, 30 m.	243
„ Calami, 15 m.	261
„ Cannab. Ind., $1\frac{1}{2}$ m.	261
„ Capsici, 1 m.	261
„ Cascara	261
„ „ Aromat., 30 m.	270
„ Chiratae, 15 m.	790
„ Cimicif., 15 m.	790
„ Cinchonae, 15 m.	290
„ Cocae, 30 m.	318
„ Colchici Sem., 3 m.	342
„ Conii, 3 m. U.S. 0.45% Conine	792
„ Convallar., 8 m.	792
„ Cypripedii (1=1) 15 m.	388
„ Digitalis, 1 m.	794
„ Echinaceae	400
„ Ergotae, 30 m.	831
„ Eriodictyi, 10-40 m.	405
„ Eucalypti, 30 m.	407
„ Euonymi, 10 m.	796
„ Eupatorii, 30 m.	797
„ Frangulae, 1-4 dr.	424
„ Gelsemii, $\frac{1}{2}$ m.	798
„ Gentianae, 15 m.	798
„ Geranii, 15 m.	623
„ Granati, 30 m.	799
„ Guaranæ, 30 m.	441
„ Hamamelid. Fol., 30m.	477
„ Hydrastis, 30 m.	480
„ Hyoscy., 3 m.	511
„ { Ipecac., Emetic, 15 m. Expt., 1 m. }		
„ Krameriae, 15 m.	804
„ Lappae, 30 m.	805
„ Leptandrae, 15 m.	805
„ Lobeliae, 8 m.	580
„ Nucis Vom., 1 m.	814
„ Phyto- { Emetic, 15m. } lacc. { Alterat., $1\frac{1}{2}$ m. }		
„ Pilocarp, 30 m.	653
„ Podophylli, 8 m.	521
„ Pruni Virginianæ (Glycero - hydro - alcoholic), 30 m.	818
„ Quassiae	818
„ Quillaie, 3 m.	684
„ Rhei, 15 m.	819
„ Rosae, 30 m.	819
„ Rubi, 15 m.	820
„ Sanguinariae, $1\frac{1}{2}$ m.	820

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Fluidextr.	Sarsaparillæ, 30 m. . .	691	Formanilid, 2 to 4 gr. . .	..	128
"	Scillæ, 1 in 1, 1½ m. . .	821	Formic Preservative ..	..	38
"	Scutellariæ, 5 to 15 m. .	822	Formidin Gze. and Tape ..	..	495
"	Senegæ, 15 m. . .	822	Formin. 5 to 15 gr. . .	..	444
"	Sennæ 30 m. . .	693	Formitrol Pastilles ..	..	131
"	Spigeliæ, 1 dr. . .	824	Formol, 124; Müller Fluid ..	..	558
"	Staphisagriæ, 1 m. . .	825	Formolyptol ..	..	131
"	Stillingiæ, 30 m. . .	825	Formosyl Dental Dressings, 129;		
"	Stramonii, 1 m. (0.25		Mouth Wash, 128; Tooth		
	per cent. alk.)		Paste, &c. 128; Gargle 129;		
	Sumbul, 30 m. . .	826	Glyc. Soap ..	..	691
"	Tritici, 1 to 2 dr. . .	776	Formosyls, Perfumed ..	581,	115
"	Uvæ Ursi, 30 m. . .	781	Formyl Terchloride, 1-5 m. . .	..	278
"	Valerianæ, 30 m. . .	769	Fortoin, 4 gr. . .	..	370
"	Veratri, 1½ m. . .	830	Fossilline ..	..	626
"	Viburni Prunif., 1 to		Fotus Acid Borici, 6 dr. to 1 pint		
	2 dr. . .	830	" Belladonnæ, 1 to 2 dr.		
"	Xanthoxyli, 30 m. . .	831	of Tinct. to 1 pint ..	..
"	Yerba Santa, 15 m. . .	831	" Opii, ½ to 1 dr., to 1 pint	..	
"	Zingib., 15 m. . .	768	" Papaveris, 2 ozs. to 1½		
Fluid-glycerates ..	..	432	pints 15 minutes;		
" Buchu ..	..	432	foment at 120° F. . .	..
" Grindelia ..	..	432	Four Gland' Tablets ..	..	935
" Sanguinaria ..	..	432	Fournier's Syringe ..	..	449
Fluorescein ..	..	635	Fowler's Solution, 2 to 8 m. . .	..	175
Fluorine ..	..	354	Fraenkel's Pneumococcus 870 &	506	
Fluoroform ..	..	773	Frambœsia, 554; Frangula ..	..	797
Fly Deterrents & Destruction	..	964	Frank Caro Process ..	..	45
" Papers, Arsenic ..	..	174	Frankincense ..	..	646
" " Sticky ..	..	831	Fraser's Root ..	..	785
Fly, Spanish or Blistering ..	..	261	Fraxinus ornus ..	..	807
Fœniculi Fructus, 797; Fœnu-			Freeman's Chlorodyne ..	..	570
greek ..	..	797	Freezing Mixtures ..	..	253
Folin's Method (Amino Acids)			French Chalk ..	..	137
374, (Nitrogen) 408 (Am-			Friar's Balsam, ½ to 1 dr. . .	..	6, 2
monia) ..	..	409	Fridericia's CO ₂ tensimeter ..	..	367
Food and Drugs Act ..	..	451	Friedländer's Pneumo. bacillus	..	506
Food Colors ..	..	456	Fröhde's Reagent ..	61,	174
Food Preservatives ..	..	452	Fromme's Strophanthus Assay	..	146
Foods, 562 <i>et seq.</i> & 94; Calorie			Frost Bite ..	..	982
Values of various, 96; Diabe-			Frost's Solution, Anatomical	..	558
tic 576; Infants', A, B, C	..	567	Fructolax, 2 to 3 dr. . .	..	626
Fool's Parsley, 774; Foot Powder	..	136	Fructose ..	..	687
Formagules (Iodoform, 492;			Fuchsine (Carbol Solution) ..	..	539
Olive Oil, 596; Santalol, 601)	..	645	" ½ to 4 gr. 308, Acid or 'S'	..	539
Formaldehyde, 124; Estima-			" Ointment ..	..	308
tion, 23; Formaldehyde			Fuchsine Aniline Green ..	..	539
Tablets, Internal ..	131, 24		" Sulphurous Acid Test	..	20
Formaldehydum Polymerisatum			Fucus Vesiculosus ..	..	797
= Paraform, 129; in Urine ..	..	397	Fullers' Earth ..	..	136
Formalin, Formol, 124;			Fuller's Inhalant ..	..	375
Chlorof. Sols., 127; Detection			Fumigators ..	..	125
in Milk, 453; Disinfecting			Fumus Potassii Nitratis ..	..	662
Tablets, 130; Gargle, 127;			Fungi, poisoning by (see Poisons		
Gut, 526; Inhalation, 127;			and Antidotes).		
as Meat. etc., Preservative,			Fungi to detect Glucose ..	..	399
23, 354, 558; for Milk	..	452	Fungus ignarius, P. Austr. . .	..	778
Room Fumigation ..	125,	355	" Laricis ..	..	774
Formalised Gelatin ..	..	423	Furfurol ..	..	25
" " Capsules ..	..	645	Furunculine, 1 dr., 273; Fusel Oil	..	120
Formamin, 444; Ethyl Iodide	..	495	Gaduol, 1 to 4 dr. . .	..	595
Formamint Tablets ..	..	131	Galangal, 798; Galbanum, 5 to		
Formamol	447	15 gr.	798
Formanganate Disinfector	355	Galega,	798
			Gale, Sweet	784

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NAME.	DOSE.	PAGE
Galium Aparine, 798; <i>Galla</i> , 7½		
gr. av.	798
Galvanometer	271
Galyi, 4 to 6 grains	208
Gambir, 788; Gamboge ½ to 2 gr.		
gr.	785
Gamgee (Gauze and Wool)		
Tissue.	437
Ganja	260
Garcinia Hanburii	785
Gardner's Syr., 1 to 3 dr.	508
Gargar Acidi Benzoici	6
„ Acid Carbolici	16
„ Aci ti Tannici	99
„ Aeruginis	380
„ Aluminis (et Co.)	428
„ Carbolica	16
„ Chlori	705
„ Formaldehydi	127
„ Formosyl.	129
„ Hyd. Co.	471
„ „ Perchlor.	464
„ „ et Zinci Cy.	456
„ Hydrog. Perox.	478
„ Lysoformi	129
„ Potass. Chlor.	705
„ „ Permang.	537
„ Resorcini	683
Garlic, ½ to 2 dr.	777
Garrod's Lozenges	730
Gas, Dental.	139
„ Gangrene	486
„ Mantles	740
„ Poisoning	1022, &	457, 458
<i>Vide also</i> Respirator Soln., p. 99.		
Gasoline	628,	130
Gastric Contents Examn.	459
„ Ulcer, 895. See also		
Therap. Index & 461 <i>et seq</i>		
Gaubius' Table of Dosage	1026
Gauducheau's Stain	499
Gautier's Pills	570
Gauze-covered Moss	716
Gauze, Bismuth Subgallas	236
„ Bromphenobis.	22
„ Carbolised	16
„ Cyanide	455
„ Iodoform, 439, 493; Picric 76		
Gauzes and Gauze Tissues,		
Ribbon and Protective and		
Tampons	437
Gazoline.	628,	130
Gee's Cough Linctus, 1 dr.	607
Gelanthum	747
Gelatin Glycerin	428
„ Injections (Tubes)	422
„ Nutrient (Bact.)	559
„ Pastils	429
Gelatina Sol. Steril.	422
<i>Gelatinum</i>	422
„ Calcii Chloridi, 5 to 7 Cc.	253
„ Formalisat	423
„ Glycerinatum	428
„ Zinci, and with Ichthyol,		
Picis 5%, Resorcin 3%	765

NAME.	DOSE.	PAGE
Gelignite	556
Gelineau's Dragées, 1 <i>p.d.</i> in-		
creased to 3	151 & 570
' Gels'	346
Genasprin, 5 to 15 gr.	86
Genatosan	44
<i>Gelsemii Radix</i> , 5 to 15 gr.	423 & 74
Gelsemin (Eclectic), ½-2 gr.	429
Gelseminina, 1/100 to 1/32 gr.	424, 74
Gelseminina HCl., 1/60 to 1/20		
gr.	424
<i>Gentiana Radix</i>	798
Gentian Violet. 308 Aniline	556
Geosot, 2 to 5 m.	377
Geraniol	121
Geranium Mac., 1 to 5 gr., 798;		
Cape.	809
Gerhard's Diacetic Test	363
German Measles	940
Germander	828
Germicides Chapter on	342
Gerrard's Test Solution	401
„ Peptonoids	633
Ghāti or Ghatti Gum	772
Giemsa's Infection, 667; Stain	511
Gibson's Dysentery Vaccine	909
Gingelli Oil	603
Gingerin, ¼ to 1 gr.	769
Gingerol	769
Ginseng	798
Gipsey Nut	829
Gitalin, Gitin	61
Glanders	488
Glands Ductless, see Gland in		
question and	158
Glandulæ Supraren Sicc., 4 gr.	924
„ Thyroideæ Sicc., 4 gr.	935
Glandulen	916
Glaser's Salt, 30 to 120 gr.	663
Glass for Technical Work	149
Glass Gall . 16th Edn., Vol. II., p. 2		
Glass Soluble, or Water	709,	710
Glauber's Salt	711
Glaucium Luteum	799
Glaxo	574
Glew's Scintilloscope	314
Glidine	576
Globin and Globulins	99, 367,	372
Glonoin, Sol., ½ to 2 m.	558
Gloriosa Superba	799
Glossaries, Arabic, Belgian,		
Danish, French, etc.	584 <i>et seq.</i>	
Glossina Palp., Morsitans	531 <i>et seq.</i>	
Glucantha	643,	748
Glucarsenol	207
Glucosennin	692
<i>Glucosum</i> , 425, 75, 94; Glucose.		
Media	559,	560
„ Surgical Dressing	427
„ Syrup	642
„ Tests for, in Urine	397
„ Tubes (for feeding)	425
„ Tryptic Broth	550
<i>Glucosimide Glusidum</i> , ½ to 2 gr.	685
Gluten	576, 104

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NAME.	DOSE.	PAGE
Glutoid Caps, Iodoform, &c.	492	645
Glycaphorm, 1 to 2 dr.	..	548
Glycine Hispida	..	824
Glycerides	..	142
<i>Glycerin</i> , 1 to 2 dr.	..	427 & 75
,, <i>Acidi Borici</i>	..	10 & 2
,, ,, <i>Carbol</i> , 1 in 5	..	17
,, ,, Emergency form	..	430
,, ,, Hydriodici, 20-	..	508
,, ,, 60 m.	..	508
,, ,, <i>Tannici</i>	..	427
,, Agar	..	560
,, Aloes	..	132
,, <i>Aluminis</i> (c. Acid Tan-	..	133, 428
,, nic, 428)	..	133, 428
,, <i>Amyli</i> , 1 to 8
,, Atropinæ	..	214
,, Belladonnæ	..	223
,, Bismuth Eff.	..	229
,, Bismuthi Nitratis	..	229
,, Bismuth. et Sod. Tart.,	..	632
,, 1 dr.	..	632
,, <i>Boracis</i> , 1 to 6	..	427 & 75
,, Broth	..	559
,, c. Aq. Rosæ	..	428
,, Di-acetyl-morphinæ,	..	548
,, 1 to 2 dr.	..	548
,, Di-iodo-hydrin	..	508
,, Eastoni, 15 m.	..	418
,, Estimation of	..	75
,, Ext. Bone Marrow,	..	912
,, 1-2	..	912
,, Ferri Dialysat., 60 m	..	411
,, ,, Perchlor.	..	410
,, Glyceroph. Co., 1 to 2	..	45
,, dr.	..	45
,, ,, c. Medulla Rub.,	..	45
,, 1 to 2 dr	..	45
,, Hyd. Perchlor.	428	463
,, Hypophosp., 1 dr.	..	640
,, Iodoformi	..	492
,, in Urine	..	406
,, Iodi (Morton's)	498,	85
,, Jelly, 428; Micro	..	75
,, Pancreatis, 1 to 2 dr.	..	619
,, Papain, 1 dr. c.c.	..	622
,, <i>Pepsini</i> , 1 to 2 dr.	..	631
,, Pessaries	..	429
,, Phosphori= Elix, 15	..	636
,, to 60 m.	..	636
,, <i>Plumbi Subac.</i>	..	653
,, Resorcin, 682; Rose	..	428
,, Water	..	428
,, Soap Liq.	..	691
,, Sodii Cinnam., 30 to 60m	28	..
,, Spirit	..	119
,, Substitutes	..	430
,, Sulphuris, 1 to 4 oz.	..	728
,, Suppositories	..	429
,, Tampons	..	429
,, Tinctures, <i>vide</i> Gly-
,, cetracta
,, <i>Tragacanthæ</i>	..	748
,, Trypsin, 5 m.	..	621

NAME.	DOSE.	PAGE
Glyceritum Acidi Tannici	..	427
,, Boroglycerini	..	10
,, Ferri, Quin. Strych.,	..	418
,, 15m.	..	418
,, Phenolis	..	17
Glycero-alcohol, 5-60 m.	..	428
,, Piperaz., 5 to 10 gr.	..	650
Glycerole Easton. 15 m.	..	418
Glycrophosphates	..	40 <i>et seq.</i>
Glyceryl Antimonite	..	151
,, Carbonates	..	75
,, Trinit., $\frac{1}{10}$ to $\frac{1}{100}$ gr.	..	556
GLYCETRACTA:—	..	430 <i>et seq.</i>
,, Aconiti, 0.4% alk., Av. 1m
,, Bellad., 0.375% alk., 1 to 2 m.
,, Calumbæ, 10-20 m.
,, Cascara, $\frac{1}{2}$ to 1 dr.
,, Catechu. 5 to 15 m.
,, Chirettæ, $\frac{1}{2}$ to 1 dr.
,, Cinchonæ, 3% alk., 8 to 25 m.
,, Cocæ. 0.25% alk., 1 to 2 dr.
,, Colchici, 0.5% alk., Av. 3 m.
,, Conii, 0.45% alk., Av. 3 m.
,, Digitalis, $\frac{1}{2}$ to 2 m.
,, Ergotæ, 10 to 30 m.
,, Gelsemii, 5 to 15 m.
,, Gentianæ 1 -3 m.
,, Hamamelid., 5 to 15 m.
,, Hydrastis, 5-15 m.
,, Hyoscy, Av., 3m., 0.075% alk
,, Ipecac., 1.1% Expt. 1 to 4 m.
,, Emetic, 30 to 40 m.
,, Jaborandi, 5-15 m.
,, Krameriæ, 5-15 m.
,, Nucis Vomica, 0.75% Strych
,, 2-6 m.
,, Pruni Virg., 5-30 m.
,, Quassia, 2 to 5 m.
,, Rhei, 5 to 30 m.
,, Sarsæ, 2 to 4 dr.
,, Scellæ, 1 to 5 m.
,, Senegæ, 5 to 20 m.
,, Sennæ. $\frac{1}{2}$ to 1 dr.
,, Tarax, $\frac{1}{2}$ to 2 dr.
,, Valerian, 5 to 20 m.
See also Fluid Glycerates.
Glycin, 4; Glycine, 4, 824;
Glycocoll, 10 to 30 gr.,	4, &	95
Glyco-gelatin and Pastils	..	428
Glycogen, $1\frac{1}{2}$ to 2 gr.	686, 799 &	95
,, Iodine reaction with
,, blood	..	390
Glycoheroin, 15 m, to 1 dr.	..	548
Glycolactophos	..	43
Glycopasta Aconiti	..	432
,, Bellad., Hyoscy	..	432
Glycoproteins	..	94
Glycosal, 5 to 30 gr.	..	92
Glycosols	..	346
Glycosuria, various	..	398
Glycothymoline	..	746
<i>Glycyrrhiza</i> , 5 to 20 gr.	432, &	76
Glycyrrhizin, Amm., $\frac{1}{2}$ to 5 gr.	433 &	76
Glykaline	..	570

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Glykeron, 15 m. to 1 dr.	..	548	Gossyp. Sal Alembroth.	..	468
GLYL:—		434	Stypticum	..	410
Amygd. Ess. sine HCN			Goulard's Extract	..	653
Anethi.		Gout, 649; Powders, 816; See		
Anisi		also Therap Ind.		
Aurant Amar.		Gouttes Amères de Baumé		
Aurant. Flor.		4 m. ..	..	581
Carui		Gowers' Glucose Test	..	408
Caryophylli		Gowland Hopkin's Method	..	415
Cinnam.		Graham on Colloids	..	346
Fœniculi		Grains de Lin	..	806
Lavandulæ	434	Gram's Method and Solution	..	556
Limonis		Jensen's Modifn.	..	489
Menthæ Pip.		Much's ..	..	540
Menthæ Vir		Gram and Non-Gram Organ-		
Myrist		isms, Table	..	557
Pimentæ		Granati Cortex	..	62
Pini		Grant's D., Inhalation, 373; In-		
Rosæ		sufflator Drops	..	28
Sassafras		Granula Dioscoridis, 1 to 5	..	17
Thymi		Granules Aconitine and nitras,		
Vanillæ		$\frac{1}{10}$ mgr	..	10
Glymol = Paraff. Liq. <i>q.v.</i>			Granules Atropine Sulph., 1		
Gmelin's Reaction	..	375	mgr.	..	21
Gnoscopine	124	Digitaline Crist., FR.C X.		
Goa Powder	288	and Amorphe	..	39
Goat Serum in Cancer, see Can-			Granules Digitaline Nat.	..	39
cer—Therap. Ind.	..		Digitoxin, $\frac{1}{20}$ gr.	..	39
Goats and Leprosy	494	Hyoscyamine, 1 hrly	..	48
Goat's Beard	829	Strophanthin, $\frac{1}{10}$ mgr.	..	72
Goat's Milk	575	Strychnine Sulph., 1		
Goat's Rue, 798; Goitre, 860,			mgr. ..	..	72
and Therap. Ind.; Gokhru	..	799	Grape Sugar	..	42
Gold and Sodium Chloride	..	219	Gray's Stovaine Dextrin Inj.	..	33
Beater's Skin	..	912	Green, Brilliant	..	309 & 35
Colloidal	..	349, 356	Malachite	..	30
Cyanide	..	660	Green Mountain Cure	..	66
Organosol	..	365	Gregory's Pill = Pil. Coloc Coi,		
Golden Seal, 10 to 30 gr.	..	474	Gregory's Powder, 10 to 60 gr.	..	68
Gomenol and Pâte	..	308	Salt	..	12
Gomme Goutte	..	785	Grenacher's Solutions	..	39
Gonal	..	601	Grey Oil, 2 to 3 gr.	..	44
Gonococcus, Vaccine	860, &	488	Powder, 1 to 5 gr.	..	44
" Detoxicated	..	862	Griffith's Mixture, $\frac{1}{2}$ -1 oz. =		
" Culture Media	..	488	Mist. Ferri Co.		
Gonorrhœa	860, 984 &	488	Grignard Reaction	..	15
Comp. Fixn. Test	..	490	Grindeline, 1 to 2 dr.	..	44
Sabouraud's Milk Serum			Grindelia	..	44
for	..	489	Grossich's Solution	..	50
Goose Nut	..	780	Ground Nut Oil	..	78
Goose Grass, 798; Goose Greese	..	550	Groundsel	..	82
Gordon's Pea-flour Ext.	..	475	Grubb's Fryers Drops	..	
Trypagar	..	475	Guanicaine	..	32
Gorit (Calc. Perox.), 3-9 gr.	..	254	Guaiaci Resina (& Liq.) 5-15		
Gossyp. Rad. Cort.	..	441	gr.	..	442, 7
Gossypium	..	436	Effects on Urine, 76; Tests		
Gossyp. Arseniosium	..	177	for Blood	..	37
Camph.	..	259	Guaiacol (Cryst. 374) 1 to 5 m.		
Capsici	..	268	374, & 58, 18		
Carbolisat.	..	16	Benz., 4 to 12 gr.	..	37
Ferri Perchlor.	..	410	Cacodyl., $\frac{1}{2}$ -2 gr.	..	18
Hyd. Iodidi	..	457	Camph., 5-10 gr.	..	37
Hyd. Perchlor.	..	466	Carb., 5 to 15 gr.	..	37
Iodi, 6%	..		Cinnam., 5-15 gr.	..	37
Menthol	..	541	Iodide, 5 to 15 gr.	..	37

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE.
<i>Guaiacal</i> Salol (Salicyl.), 15-75 gr.		377	Gutzeit's Test, 30 ;	Gyno-	
„ Sulphonate (Pot.).		377	cardia		587
„ Valer., 3 m.		377	Gypsum (Calcii Sulphas)		255
Guaiacamphol		376	Gyrol Pencil		267
Guanidine, Guanin		412	H aarlem Drops		648
Guarana, 10 to 60 gr.		799	Hæmaboloids et c. Arsen. et		
Guaranine, 1 to 5 gr.		243, 799	Strych., $\frac{1}{2}$ oz.		412
Guarea		791	Hæmacytometers		381
Guaycuru, 799; Guaza, 260;			Hæmalum and Acid		390
Guimauve Pastils		429	Haemaggluti in Reaction		389
Guinea Worm		491	Hæmatein (Hæmatin 378)		799
Guipsine.		831	Hæmatocrite		381
Gum Acacia, 771; <i>Ghatti</i>		772	Hæmatoporphyrin		376
Gum Acac. Intravenous, 771,			Hæmatoxylin, 799; Test Solu-		
148 ; Section Cutting		558	tion		170, 390
Gum, Blue		403	<i>Hæmatoxyli Lignum</i>		799
„ Plant		441	Hæmoglobin and Caps, 1 to 2 dr.		566 & 99
„ Thus		646	„ Scale Tallquist		380
<i>Gummi Indicum</i>		772	Hæmoglobinometers		380
Gun-cotton		343	Hæmolysin		833 & 516
Gunther's Bacillus		5	Hæmomanometers		388
Günzberg's Capsule		463	Hæmoplastin		896
„ Test for HCl.		461	Hæmoptysis (v. also Therap-		
Gurjun Balsam, $\frac{1}{2}$ to 2 dr.	782 &	123	Index		148
Gut; Chromic, Iodised, etc.		526	Hæmorrhagic infective Jaundice		554
Guttæ; Ac.			Hæmostatic Serum		896
Salicyl. Co., 81; Adrenalin,			Haffkine's Prophylactic		502
927; Alum. Acet., 134; Atro-			Hair Dye, Mrs. Potter's Walnut		
pinae Sulph., $\frac{1}{4}$, $\frac{1}{2}$, 1 and 2%,			Juice		300
214; Atropinae c. Cocaina,			Hair Dyes, 29 ; Henna,		
214; Atropinae c. Zinco, 214;			800; Hydrog. Perox., 477;		
Atropinae et Quininae, 214;			“One Solution,” 29 ;		
Castor Co. 1 dr., 787; C.			Pot. Permang. 536; Pyro-		
Chlorof. cum Menthol Co.,			gallol		29
285; Cinnamon Co., 373;			Hair Lotion, Amyl Nit. and		
Cocaina Hydrochloridi, 323;			Pilocarpine		150
Cocaina Oleosæ, 320 (and Fac-			„ „ E. Wilson's		142
tory Act); Cupri Sulphatis,			Hair's (Dr.), Cure for Asthma		570
381; Daturinae, $\frac{1}{4}$ %, 487;			Halazone Tablets		64
Dionin, 548; Duboisinae, 487;			Haldane's Hæmoglobinometer		380
Eucainae, 330; Hectine. 208;			Halliburton's Test		380
Homatrophinae, 1%, (et c.			Haldane Oxygen App...		613
Cocaina), 217; Hydrargyri			Hallam Moss		718
Nitratis (Aural), 461; Hydro-			Halogens in B.P. Salts		138
gen Perox., 477; Hyoscinae,			Hall's Wine		570
0.5% (et c. Cocaina), 482;			Halphen's Test		120
Hyoscyaminae, 487; Iodi			Hamamelidin, $\frac{1}{2}$ to 2 gr.		443
Farrer 1004; Morphinae et			<i>Hamamelidis Cort. et Fol.</i>	443.	77
Cocaina (Aural), 544; Physo-			Hamilton's Pill..		367
stigninae, 0.06 to 1% (et. c.			Hammond's Remedy		174
(Cocaina), 642; Physostig-			Handkerchiefs, Aseptic		437
minae et Quininae, 642; Pilo-			Harmalin		308
carpinae, 0.5%, 522; Quininae			Harmal, Harmaline, Harmine	799,	800
Formatis, 2%. 666; Rosæ, 2			Harrogate Salts 437 ; Water		437
to 10 m., 545; Sodii Arsenitis			Hartshorn and Oil		141
et Ferri, 5 m., 179; Zinci			Harvard Liquid, 807; Harvey's		
Chloridi (et c. Cocaina), 763;			Pills, 571 ; Hashish		260, 48
Zinc Chlorid (Aural), 764;			Haust. Cascara Sag., 1 oz.		270
Zinc Chlorid. c. Adrenalin,			„ Choralamidi, 1 oz.		278
763; Zinc Sulphat. 768.			„ Copaibæ, 1 oz.		602
Gutta-Percha and Tissue	264,	265	„ Creosoti, $\frac{1}{2}$ to 1 oz.		374
Guvacine		148	„ Filicis, 1 oz.		421
Gymnema		799	„ Imperialis		663
Guy's Tonic		570			
Gynoval Caps 1 t.d.s.		761			

FIGURES IN HEAVY TYPE, *e.g.* **100**, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Haustr. Nitroglycerini, 1 oz. . .		553	<i>Hexamina</i> = Hexamethylen-tet-		
„ Santonini et Ol. Ricini,			ramine, 5 to 15 gr. . .		444
„ 1½ oz. . .		688	„ Experiments with		77, 150
„ Sulphonal, 1 oz. . .		727	„ Anhydro methylene cit.,		
„ Terebeni. . .		735	15 gr. . .		447
„ Trional, 1 oz. . .		728	„ Benzoate, 5 to 15 gr. . .		446
Hayem's Blood Fluid . .		381	„ Borate, 15 to 60 gr. . .		446
„ Solution (Serum) . .		701	„ Camphorat., 8 to 12 gr. . .		447
Hay Fever, 862; Nebulæ . .		555	„ Ethyl-Bromide . .		239
„ Vaccines . .		863	„ Salicylate, 5 to 15 gr. . .		446
„ Anaphylaxis in . .		863	„ Sod. Acet., 30 gr. . .		447
(See also Therapeutic Index).			„ Sodium Benzoate . .		446
Hazel Foam and Comps. . .		443	Hexamine Resorcin . .		447
Hazeline, ½ to 3 dr. . .		443	Hexaminoarsenobenzene . .		209
Head and Headache Powders		571	Hexanitrin, 1 gr. . .		402
Heal-All. . .		791	Hiera Picra, 3 to 10 gr. . .		132
Health Resorts. . .		447	High Explosives . .		75, 300
Heart Extract, for Syph. Test			High Frequency . .		301
517 ; Tonic Units 16th Edn.,			Hill Diarrhœa . .		510
Vol. II. 58			Hartley's Test . .		364
Heat Treatment . .		302, 303	Hill's (Leonard) Oxygen Bag . .		613
Heather . .		542	Hill's (William) Oesoph. Catheter		327
Heberden's Ink, = Mist. Ferri			Himalayan Oils. . .		800
Arom., '85, 1 to 2 oz.			Himrod's Cure . .		662
Hectargyre . .		208	Hindu Dates . .		827
Hectine, 0.1 to 0.2 Gm. . .		208	Hippocastanum . .		774
Hedera, 800; Hederin. . .		800	Hippocras, 769; Hippurates . .		8, 9
Heimer's Test . .		454	<i>Hirudo</i> . .		914
Heidenhain's Stain . .		390	Hirudin . .		914
Heiser's (Chaulmoogra) Injn.,			Hiss' Culture Medium . .		552
½ to 10 Cc. . .		589	Histamine . .		399, 71, 151
Helalin, 791; Helba . .		407, 797	Histidine . .		399, 374
Helenin, ¼ to 2 gr. . .		802	Histones. . .		99
Hellianthin . .		464	Hoffman's Anodyne, 60 to 90 m.		111
Helicon, 5-15 gr. . .		86	Hog Cholera . .		491
Heliotropin . .		800	Holadin . .		621
Helium 320 , Commercial Use . .		321	Holarrhena . .		800, 150
Hellebore, Black, Green, 1-5 gr.,			Holloway's Ointment & Pills . .		571
White. . .		830	Holocaine HCl. . .		331
Heller's Test = Acid Nitric . .		370	<i>Homatropinæ</i> HBr., 1/80-1/20 gr.		216
Hellige Colorimeter . .		395, 416	„ HCl., 216; Salicyl, 1/80		
Helmerich's Pomade . .		731	to 1/20 gr. . .		216
Helmitol (Tablets, 7½ gr.), 15 gr.		447	Homatropine . .		211, 216
Helonias dioica. . .		800	Homocamphor . .		149
Hematic Hypophosphites . .		640	Honey, 806, 93 ; Water . .		120
Hemidesmi Radix . .		800	Honeysuckles . .		806
Hemisine . .		926	Hood's Preps.; Hooper's Pills. .		571
Hemlock (Lesser, 774), 367;			Hop and Pillows, Smoking . .		806
Spruce, 815; Water. . .		790	Hordenine, 800; Horehound, 30gr		807
Hemp, Canadian, 164; Russian		785	Horlick's M. Milk tabs. . .		97
Henbane, 485; Egyptian . .		486	Hormonal, 15 to 20 Cc., child-		
Henna . .		800, 150	ren less . .		923
Hepatic Abscess . .		513 & 495, 510	Hormones . .		917 & 158
Hepol, 30 to 120 m.t.d. . .		595	Hormotone Tabs. . .		936
Heracleum . .		800	Horrocks's Water Testing		
Herbe aux Chantres . .		796	Method . .		420
Hermann Perutz Reaction . .		523	Horse-chestnut, 774; Horshair		527
Herogen, 2 dr. . .		566	Horsenettle . .		823
Heroin HCl., ½ to ⅓ gr. . .		548	Horseplasma . .		895
Hetol, 3 to 5 gr. . .		28	Horseradish . .		791
Heusner's Glue . .		808	Horse Serum . .		895
Hctraline, 8 to 30 gr. . .		447	Horsley's Wax . .		788
Hevea Brasiliensis . .		264	Horticultural Poisons . .		172
Hexachlorethane . .		114	Horton, Life Cycle of Bacteria. .		902
Hexavaccine . .		901	Hound's Tongue . .		792

FIGURES IN HEAVY TYPE e.g. 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Household Ammonia	141	Hyd. Nitroso-Nitrate ..	..	370
Hübl's Iodine Solution	85	<i>Oleatum</i> ..	..	..
Huile Camphrée	258	<i>Oleatum</i> , 5, 10, 20 & 25%	..	583
de Bouleau	652	et (c. Morphina) ..	..	471
de Cade	652	<i>Oxidum</i> (-ous) ..	..	471
" Foie de Morue	592	" <i>Flavum</i> ..	..	472
Creosot. Iodof.	492	" <i>Rubrum</i> , $\frac{1}{4}$ to 1 gr.	..	473
d'Iodure Mercurique, 1 Cc.	..	457	<i>Oxycyanidum</i> ..	454 & 80	472
d'oelette	597	<i>Oxysulphas</i> ..	..	472
de Pétrole	628	<i>Peptonas</i> , <i>per os</i> , $\frac{1}{2}$ to 1½	..	461
Grise Injectable, 2 to 3 gr.	..	449	gr., hyp. $\frac{1}{8}$ gr.	..	461
Lourdes de Pétrole	624	<i>Perchloridum</i> (Wool, 466),	1/32 to 1/16 gr.	450, 461
Hulle's Soluble Strychnine	725	& 356	..	467
Humbergum	604	with Serum ..	..	467
Humulus Lupulus	806	<i>Persulphas</i> , 2 to 5 gr. ..	..	472
Huppe's Bacillus	5	et Potass-Hyposulph., $\frac{1}{8}$ gr.	..	468
Hurtley's Test	364	hyp. ..	..	468
Huxham's Tincture, $\frac{1}{2}$ to 1 dr.	..	290	et Potass Iod., 1/16 to	..	458
Hyaline Cartilage	565	$\frac{1}{4}$ gr. ..	..	458
Hycol	35	" Tablets, 80; see also	..	459
Hydatid Fluid	378	Solubus Biniodide ..	..	459
Hydnocarpus	588	<i>Protoiodid</i> , $\frac{1}{8}$ to 1 gr. ..	..	459
Hydramyl, 628; Hydrangea	800	<i>Rhodanidum</i> ..	..	474
<i>Hydrargyrum</i>	448, 79	<i>Salicyl.</i> , $\frac{1}{8}$ gr. ..	450, 468, 81	..
Colloidal ..	349, 362, 364	..	<i>Salicyl.-Arsenas</i> ..	..	179
Ionisation	278	<i>Soziodol</i> ..	..	496
Hydrarg. Amalgam	452	<i>Stearas</i> ..	..	584
Hyd. Amido-Acetas, $\frac{1}{8}$ gr.	4	<i>Subchloridum</i> , $\frac{1}{2}$ to 5 gr.	450, 469	..
Amino phenylarsonas, $\frac{3}{4}$..	187	" Duret's Form Cryst.	469, 79-	..
gr. incr.	452	<i>Succinas</i> , $\frac{1}{4}$ to $\frac{1}{8}$ gr. ..	..	471
<i>Ammoniat</i>	474	<i>Succinimid</i> , $\frac{1}{4}$ to $\frac{1}{8}$ gr. ..	450, 471	..
<i>Anthranilas</i>	187	<i>Sulphanilas</i> ..	..	474
<i>Arsanilas</i> , $\frac{1}{2}$ to 1 gr.	187	<i>Sulphas</i> , <i>Subsulph.</i> , 2 to 5 gr.	472	..
<i>Atoxylas</i> , $\frac{1}{2}$ to 1 gr.	453	<i>Sulphidum</i> ..	..	473
<i>Benzoas</i> , 1/50 to 1/10 gr.	461	<i>Sulphocyanidum</i> ..	..	474
<i>Bichloridum</i> = <i>Perchlori-</i>	..	456	<i>Sulphuret</i> c. <i>Sulph.</i> ..	..	473
<i>dum</i> , 1/32 to 1/16 gr.	456, 458 & 80, 356	<i>Tannas</i> , 1½ gr. ..	..	472
<i>Bijodat</i> (Biniodid)	461	<i>Thymol Acetas</i> , $\frac{1}{2}$ to 1 gr.	..	474
<i>Biniodidum</i> , 1/16 to $\frac{1}{4}$ gr.	..	461	et <i>Zinci Cyanidum</i> ..	455 & 356	..
<i>Bisulphid.</i> or <i>Bisulphuret</i> ,	..	473	<i>Hydrarsan</i> , $\frac{1}{2}$ oz. ..	..	177
P.L. '51 = Vermilion.	454	<i>Hydrastin</i> $\frac{1}{2}$ to 2 gr. ..	..	475
<i>Bromidum</i> , 1/16 to $\frac{1}{4}$ gr.	454	<i>Hydrastina</i> (Alk.), $\frac{1}{2}$ to 1 gr. ..	475, 82	..
<i>Carbolas</i> , $\frac{1}{2}$ to 2 gr.	469	<i>Hydrastinæ</i> HCl., $\frac{1}{2}$ to $\frac{3}{4}$ gr. ..	476, 82	..
<i>Chloratum mite</i>	469	<i>Hydrastininæ</i> HCl., $\frac{1}{2}$ gr. ..	474 & 81	..
<i>Chloridum</i> = <i>Subchlori-</i>	..	461	<i>Hydrastis</i> , 10 to 30 gr. ..	..	25
<i>dum</i> , $\frac{1}{2}$ to 5 gr.	461	<i>Hydrazine</i> ..	..	303
<i>Chloridum Corrosivum</i>	469	<i>Hydrazobenzene</i> ..	..	114
" Mite, U.S. = <i>Subchlor.</i>	469	<i>Hydriodic Ether</i> ..	..	457
c. <i>Creta</i> , 1 to 5 gr. ..	448, 79	..	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Cyanidum</i> , 1/20 to $\frac{1}{4}$ gr. ...	450, 454 & 356	..	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Glycocoll</i> , $\frac{1}{8}$ gr.	471	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Imido-Succinas</i> , $\frac{1}{4}$ to $\frac{1}{8}$ gr.	65	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Iodas</i> , $\frac{1}{8}$ to $\frac{1}{4}$ gr.	459	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Iodidum Flavum</i>	459	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
" (-ous), $\frac{1}{8}$ gr.	459	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Iodidum Rub.</i> , 1/32 to	..	459	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
1/16 gr. 456, 458, 80, 356	..	459	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
" <i>Viride</i> , $\frac{1}{8}$ to 1 gr.	459	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Lactas</i> , $\frac{1}{8}$ gr. hyp., <i>per os</i> ,	..	450, 460	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
1/5 gr.	474	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Meta-sulphanilas</i>	473	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Naphthol-Acetas</i> , $\frac{1}{2}$ to 1 gr.	460	<i>Hydriodol</i> , 3 to 6 m. ..	..	465
<i>Nitras</i>	460	<i>Hydriodol</i> , 3 to 6 m. ..	..	465

FIGURES IN HEAVY TYPE, e.g. 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Hydrogenit		616	Ichthyol Paste, 489; Resorcin,		
Hydrolete		616	489; Salicyl		489
Hydrophobia		507	Ignatia Amara Beans		580
Hydropyrin		91	Ihle's Paste		683
Hydroquinine HCl.		378, 379	Ilex Paraguayensis		248
Hydroquinone, $\frac{1}{2}$ to 5 gr.		801	Illey Water		438
„ Developers		291	Illipei		784
Hydroxylamine, HCl. & Sulph.		801	Iminazoylethylamine		399, 71
Hydroxy-caffeine, 1 to 5 gr. or more		247	Immune Body		834, 517
Hydroxycodine		124	Immunisation		833 et seq.
Hydroxyphenylserines		154	Immunity Reaction		835
Hydroxy-phenylethylamine		399, 927	Imperial Drink		665
Hydroxyphthalophenon, $\frac{1}{2}$ -8 gr.		634	Incubation periods of infectious diseases		940
Hydroxyl, 477; Group, effect of		258	Indaconitine		17
Hyodin, 1 to 3 dr.		508	India Rubber		264, 49
Hyoscina		480 41, 83	„ „ Paste for Mulls		49
<i>Hyoscine HBr.</i> , 1/200 to 1/100 gr. or less		482	In-Cwadi		785
„ HCl. & HI., 1/200 to 1/100 gr. or less		485	Indian Hemp, Amer., 164; White, 782; <i>Squill</i>		829
<i>Hyoscyami Folia</i>		485, 84, 150	Indian Ink		513
„ Mutic Fol.		486	Indian Lemon Grass, 813; Licorice, 771; Pink Root, 824; Root		798
„ Semina, 2-10 gr.		441	Indican		407
<i>Hyoscyamina</i> , 1/200 to 1/100 in cr.		487, 41	Indicators for Vol. Analysis		170
<i>Hyoscyaminæ HBr. et Sulph.</i> , 1/200 to 1/100 gr.		487	Indigo, 53, 404; Carmine, 53; Red, 89; Soluble, Sulphate, Indigotin, 53; Indol-Indoxyl		407
Hyperchlorhydria		463	Indol Reaction		424
Hyperol		479	Industrial Methyl. Spirit		121
Hypertonic Saline, 699; Alkaline		700	Inebriety		117, 211, 290
Hypnal, 15 gr., 315; Hypnogen		753	Infant Feeding		567 et seq. 98
Hypnone, $1\frac{1}{2}$ to 5 m.		2	„ in Tropics		573
Hypnotic Drugs Army Council Order		953	„ Foods „A,” „B,” „C,” and Cocoa		569
Hypobromite Sol.		414	„ Mortality		570
Hypochlorhydria		460 et seq.	„ Starch for		573
Hypochlorite Antiseptics		49 et seq. 354	Infectious Diseases Table		940
„ Dakin's		56, 57, 354	Influenza 983; Vaccine, 864; Bacillus		864 & 491
Hypod. Injections, to sterilise		264	„ Infective Period		940
„ Purgatives: Aloin, 133; Apocodeine, 341; Colocynthin, 367; Hormonal		923	„ Filtrable Virus of		867
„ Sterules, see Sterules.			„ Periodicity		492
„ Syringes		323	„ 'Spanish'		867
„ Tabs., v. Tablets, Hypodermic.			„ War Office Conf. Vaccine		865 & 492
Hypophosphites		638 et seq.	„ In India		867
Hypophysis		917	„ Detoxicated Vaccine		867
Hypophysin		920	Infundibular Ext., $\frac{1}{2}$ to 1 Cc.		919
Hysterionica		382, 802	Infundin		920, 922
Hysterol		761	Infusa Concentrata		490
Ibogaine and HCl., $\frac{1}{2}$ - $\frac{1}{2}$ gr.		802	„ <i>Alstonia</i> , $\frac{1}{2}$ to 1 oz.		778
Ice Bags, 265; Iceland Moss 789, 150			„ * <i>Anthemidis</i> , 1 in 20, 1 to 4 oz.		780
Ichthalbin, $\frac{3}{4}$ to 15 gr.		489	„ * <i>Aurantii</i> , 1 in 20, & * <i>Co.</i> , $\frac{1}{2}$ to 1 oz.		
Ichthoform		490	„ * <i>Buchu</i> , 1 to 2 oz.		241
Ichthosulphol		487	Inf. * <i>Calumbæ</i> , $\frac{1}{2}$ to 1 oz.		785
„ Proteinate		489	„ * <i>Caryophylli</i> , 1 in 40, $\frac{1}{2}$ to 1 oz.		
Ichthyocolla		802	„ * <i>Cascarilla</i> , $\frac{1}{2}$ to 1 oz.		787
Ichthyol, Amm., Lith. Sod. Zinc.		487 et seq.	„ * <i>Chirata</i> , $\frac{1}{2}$ to 1 oz.		790

* Also Conc., i.e., 8 times strength v. p. 490, 491.

FIGURES IN HEAVY TYPE, *e.g.* 100 REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Inf. <i>Cinch. Acid</i> , $\frac{1}{2}$ to 1 oz. . .		318	Inj. Apocodeinæ, 30 m. . .		341
„ <i>Cocæ</i> , 4 to 8 oz. . .		791	„ <i>Apomorph.</i> , 5 to 10 m. . .		165
„ <i>Condurango</i> , $\frac{1}{2}$ to 2 oz. . .		791	„ <i>Argenti Nit.</i> (urethral) . .		168
„ * <i>Cuspariæ</i> , 1 in 20, 1 to 2 oz. . .		387	„ <i>Arsen. Iodid.</i> , 6 m. . .		177
„ * <i>Digitalis</i> , $\frac{1}{4}$ to $\frac{1}{2}$ oz. . .		798	„ <i>Arsen. et Ferri</i> , 1 Cc. . .		179
„ <i>Ergotæ</i> , 1 to 2 oz. . .		491	„ <i>Arsen. et Strych.</i> , 5 to 10 m. . .		179
„ <i>Gentianæ Co.</i> , $\frac{1}{2}$ to 1 oz. . .		799	„ <i>Arsen. et Strych. et Quin.</i> , 5 to 10 m. . .		179
„ „ <i>Conc.</i> . .		800	„ <i>Atropinæ</i> , 2 to 8 m. . .		214
„ <i>Gokhru</i> , 20 oz. daily . .		800	„ <i>Bismuthi Subnitratis</i> . .		231
„ <i>Hemidesmi</i> . .		475	„ <i>Brou.</i> (urethral) . .		571
„ <i>Hydrastis</i> . .		804	„ <i>Cacodylat Co.</i> , av. 17 m. . .		182
„ <i>Kava-Kava</i> , $\frac{1}{2}$ pint . .			„ <i>Caffeinæ Hyp.</i> , 1 to 6 m. . .		246
„ * <i>Krameria</i> , 1 in 20, $\frac{1}{2}$ to 1 oz. . .			„ <i>Camphoræ Hypod.</i> , 10 to 30 m. . .		258
„ <i>Lini</i> , 1 in 30, <i>Liquorice</i> , 1 in 90, <i>ad lib.</i> . .			„ <i>See also Sterules Hyp.</i> . .		
„ * <i>Lupuli</i> , 1 in 20, 1 to 2 oz. . .		807	„ „ <i>Hyp. Aether</i> , 10 m. . .		258
„ <i>Marrubii</i> . .		809	„ <i>Cocainæ Hyp.</i> (5%), 5 to 10 m. . .		323
„ <i>Menyanthis</i> , 2-6 oz. . .		818	„ <i>Cocainæ et Nitroglycerini</i> up to 15 m. . .		324
„ <i>Polygalæ Co.</i> , $\frac{1}{2}$ -1 oz. . .		819	„ <i>Codeinæ Hyp.</i> , 6 m. . .		340
„ * <i>Quassia</i> , $\frac{1}{2}$ to 1 oz. . .		822	„ <i>Coninæ HBr.</i> , 1 to 3 m. . .		368
„ * <i>Rhei</i> , 1 in 20, $\frac{1}{2}$ -1 oz. . .		826	„ <i>Coninæ</i> HBr., 1 to 3 m. . .		793
„ * <i>Rosæ Acidum</i> , $\frac{1}{2}$ -1 oz. . .		826	„ <i>Curare Hyp.</i> , 1 to 6 m. . .		258
„ * <i>Scoparii</i> , 1 in 10, 1 to 2 oz. . .		811	„ <i>Curschmann's</i> , 15 m. . .		375
„ * <i>Senegæ</i> , $\frac{1}{2}$ to 1 oz. . .		781	„ <i>Durant's</i> . .		397
„ * <i>Sennæ</i> , $\frac{1}{2}$ to 2 oz. . .		830	„ <i>Ergotæ Hyp.</i> , 5 to 10 m. . .		398
„ „ <i>Conc.</i> . .		831	„ <i>Ergotoxinæ</i> , 2 to 15 m. . .		331
„ * <i>Serpentariæ</i> , $\frac{1}{2}$ -1 oz. . .		826	„ <i>Eucaïn</i> , Lact. . .		30
„ <i>Simarubæ</i> , 1 oz. . .		826	„ <i>Fibrocoumarin</i> , 25 m. . .		375
„ <i>Symphiti</i> , 1 to 2 ozs. . .		811	„ <i>Gualacol c. Durant</i> . .		375
„ „ <i>Conc.</i> , 2 to 4 dr. . .		811	„ <i>Gualacol c. Iodoform</i> . .		217
„ <i>Tabaci</i> . .		777	„ <i>Homatropinæ</i> , 1 to 6 m. . .		457
„ <i>Uvæ Ursi</i> , $\frac{1}{2}$ to 1 oz. . .		372	„ <i>Hyd. Biniiodidi</i> (vaginal) . .		454
„ * <i>Valerianæ</i> , 1 in 40, $\frac{1}{2}$ to 1 oz. . .		139	„ „ <i>Cyan.</i> , 2 to 10 m. . .		448, 1008
„ <i>Vincæ Majoris</i> , 5 oz. . .		372	„ „ <i>Intramusc.</i> , 10 m. . .		454
„ <i>Violæ Tricolor</i> . .		539	„ „ <i>Oxycyanid.</i> . .		449
Ingluvin, 5 to 20 gr. . .			„ „ <i>Surg. Adams</i> , 5 m. . .		450
Inhalation Allyl Sulph. . .			„ „ <i>Intrav.</i> . .		457
Inhalations, Continual, 127, 372; Oro-nasal . .			„ „ <i>Iodid, Ragazzoni</i> , 2 to 6 m. . .		448
Inhaler, Ammon. Chlor. . .			„ „ „ . .		461
„ „ <i>Nasal Ozonic, Ozonic, Poor Man's, Portable</i> . .			„ „ <i>Perchlor.</i> , 1/16 gr. in 10 m. . .		466
INJECTIONS, HYPODERMIC:—			„ „ <i>Perchloridi</i> (Uterine and Vaginal) . .		449, 470
Inj. <i>Acid, Carbol.</i> , 5-20 m. . .		67	„ „ <i>Subchlor.</i> , 10 m. . .		450, 472
„ „ <i>Lactici</i> (laryngeal) . .		773	„ „ <i>Succinimidi</i> , 10 m. . .		482
„ „ <i>Osmici</i> , 1% . .		79	„ <i>Hyoscine</i> , 5 to 10 m. . .		487
„ „ <i>Salicyl.</i> . .		400	„ <i>Hyoscyaminæ</i> , 1/200 gr. inc. . .		498
„ „ <i>Sclerotic</i> . .		297	„ <i>Iodi. Hyp. Fortiss</i> , 3 to 5 m. . .		498
„ <i>Acriflavine</i> . .		332	„ <i>Iodi, C.L.T.E.</i> (also Douche) . .		17
„ <i>Alypin c. Suprarenin</i> . .		155	„ „ <i>Carbolisati</i> (Uterine) . .		492
„ <i>Antimonii Intramusc.</i> , 162; <i>Cinnamica</i> , 15 to 30 m. . .		151	„ <i>Iodoformi</i> (bladder) . .		493
„ <i>Antimonii Oxidi</i> , 15 to 30 m. . .		154	„ „ <i>Ætherea</i> . .		375
„ „ <i>Ox Fortior</i> . .		157	„ „ <i>c. Guaiacol</i> . .		493
„ „ <i>Pot. Tart. Castellani</i> , $\frac{1}{2}$ to 1 Cc. . .		159	„ „ <i>c. Menthol</i> . .		696
„ <i>Antimonii Sod. Tart.</i> . .		314	„ <i>Iodolysin</i> . .		525
„ <i>Antipyrin</i> , 8 to 30 m. . .		314	„ <i>Lecithin</i> , 1 Cc. . .		758
„ „ <i>et Cocainæ</i> , 8 to 30 m. . .			„ <i>Luminal-Sodium</i> , 2 to 3 Cc. . .		540
			„ <i>Menthol, C.L.T.E.</i> . .		543
			„ <i>Morphinæ, Acet.</i> , 1 to 2 m. . .		544
			„ „ <i>et Atropinæ</i> , 1 to 3 m. . .		

* Also Conc., *i.e.*, 8 times strength *v.p.* 490, 491.

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" " (Sulph.) for War ..		546	Intoxicant Drugs ..		953
" Nitroglycerin, 1 to 4 m. ..		558	Intramaine, Intramuscular, 2½ Cc. 413		
" Novocain cum Suprarenin ..		333	" Intravenous, 20 to 100 Cc. 413		
" Nuclein, 15 m. ..		275	See also Vol. II. p. 73.		
" Ol. Chaulmoogr. ..		589	Intra-spinal Anæsthesia 328, 336		
" Physostigmin., 1 to 4 m... 642			Introduction Vol. I. xxvi., Vol. II. xxi.		
" Picrotoxini, 3 to 6 m. ..		815	Inula Helenium, 802; Inulin 687, 802		
" Pilocarpin Nit., 2 to 6 m. 522			Invert Sugar, 686, 142 ; Invertase 69		
" Plumbi (vaginal) ..		654	Invigoroids ..		571
" Pot. Permang. (vaginal) ..		537	Iod-eosin ..		16, 386
" Quin. H.Br. Ac., 3 to 12 m. 666			Iodargol ..		364
" " HCl. Ac., 3 to 12 m... 668			Iodatol ..		499
" " HCl.-Sulph., 2 to 12 m. 679			Iodeol, 1. Cc. ..		364
" Ragazzoni, 2 to 6 m. 450, 457			" Caps. and Ovules ..		364
" Sal-Alembroth, 10 m. ..		468	Iodex, and with Meth. Sal. ..		506
" Salvarsan c. Novocain ..		202	Iodicin ..		599
" Sodii Arsenitis et Ferri No. 1 and No. 2, 1 Cc. ..		179	Iodine ..		496 & 84, 357
" Sodii Arsen. et Strych., 5 to 10 m. ..		179	" Albumen Comps. ..		506
" " c. Quin., 5 to 10 m. ..		179	" Colloid Sol. ..		357
" Sodii Cacodyl., 15 m. ..		182	" Comps., Organic 507, 85		
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" " Coumaratis, 25 m. ..		30	" in Benzene ..		504
" " Morrhuat., ½ to 4 Cc. 595			" " Dichlorethylene ..		287
" " Nucleinat. ..		275	" Iontophoresis of ..		277
" " Salicyl., 15 to 30 m. 86			" Jelly ..		499
" Sparteinæ, 2 to 6 m. ..		715	" ' Nascent ' ..		497
" Strych. HCl., 5 to 10 m. ..		725	" Numbers of Fats ..		85
" " Sulph., 1 to 6 m. ..		725	" in Paraffin ..		505
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" Thiosinamin et Phenazone, 8 to 15 m. ..		695	Iodinol, 30 to 45 gr. ..		499
Thiosinamin c. Sod. Salicyl., 15 to 30 m. ..		695	" c. Ext. Malti, 1 oz. ..		499
" Thorii Oxidi ..		740	Iodised Gut, 526; Phenol and dil. Injn. ..		17
" Trypsin Hyp., 30 m. ..		621	Iodised Wool, 6% ..		501
" Zinc Sulphatis (Vaginal) 767, 768			Iodival, 5 gr. ..		506
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" Calcis Iodatis c. Bism. 65			" -Glyc. Sol., 1 in 50 ..		498
" Eucalypti ..		796	" -iso-propyl-alcohol ..		508
" Iodoformi & Comps... 493			" protein, 10 to 15 gr. ..		506
" Menthol (& Comps.).. 540			" " Tablets, 10 gr. ..		507
" Orthoformi c. Resorcin 332			" -Tannin Syrup, ½ to 2 dr. ..		501
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Iodolysin, Inj., Sol., Pigment.		696	<i>Jasmine, Yellow</i> ..		423
Iodosol ..		506	Jaundice Epid. ...		554
Iodostarin Tabs., 3 gr., 1 to 3 <i>t.d.</i>		509	Jecovol ..		46
<i>Iodum</i> ..		496 & 84	Jellax ..		625
<i>Iodum</i> , Collodial ..		357	Jelly Fish Stings ..		653
„ Oleatum, 10 % ..		500	Jennerisation ..		904
Iohydrin. ...		508	Jenner's Stain ..		385
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Ionium, 312; Ionone ..		831	Jephson's Powder, 60 gr. ..		729
Ions, Hydrogen and Hydroxyl		391	Jequiritol, Serum, Jequirity, 771; Jesuits' Drops, 7; Jeyes Fluids ..		36 & 344
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<i>Ipecacuanha</i> , $\frac{1}{2}$ to 2 gr. exp., 13 to 30 gr. emetic. ...		509 & 85	Johne's Disease ..		492
„ s. Emetina, 5 to 20 gr. ...		509	Johnson's Saccharimeter ..		405
Ipecine ..		512	Jonnesco's Injections, 1 Cc. ..		338
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Iridin, <i>syn.</i> Irisin, 1 to 3 gr. ..		802	Joulie's phosphate, 709; Ratios		411
Iridium (Collodial) ..		349	Jubol Tablets ..		776
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Irish Moss ..		790	Jujubes, 429; <i>see also</i> Trochisci G.		
Iron Alum, 3 to 10 gr. ...		419	Jumble Beads, 771; Juniper Tar Oil, 652; Juniperus ..		803
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„ Comps., Organic. ...		412	Jusquiamine, 485; Jute, 792, 437; Juvenia; Ju-vis ..		572
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„ Japanese ..		775	<i>Kaladana</i> , 803; Kalandura ..		794
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Isopilocarpine ..		37	Kamala, 30 to 120 gr. ..		421
Iso-Emetine ..		149	Kangaroo Tendon ..		527
Isotonic Boric Acid Lotion ..		11	<i>Kaolin</i> ..	136; <i>Per os</i>	90
„ Cocaine Lotion ..		324	Kaposi's Ointment ..		552
„ Quinine Injection ..		670	Kaputine; Karox ..		572
„ Plasma. ...		702	Kargon Compound, 572;		
„ Saline Solution ..		697	Kasak, 1 to 2 dr. (children), adult $\frac{1}{2}$ oz., 270; Kasena, 1 dr. (children), adult $\frac{1}{2}$ oz.,		270
„ Sugar Solution ..		686	Kasco Tubacyllus ..		572
„ Sod. Bic. Solution ..		704	Kastanol, 774; Kat. ..		271
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<i>Ispaghula</i> , 45 to 150 gr. ..		803	Kathode ..		267
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Ixora, 30 to 45 grs. ..		520	Keating's Pectoral Lozenges ..		572
Jabon, F.E. = Sapo, Jaconet	265		Keene's Cold Cure ..		572
Jaborandi, 5 to 60 gr. ..	520 & 87		Kefir, 574 & 5; Kelene ..		112
Jaffe's Indican Test ..		407	Keller-Kiliani Test ..		61
<i>Jalapa</i> , 5 to 20 gr., 523; <i>Jalapæ</i> <i>Resina</i> , 2 to 5 gr. ..	523 & 87		Kelp, 496, 84; Kelly's Paint. ...		344
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Jamaica Dogwood ..		816	Kelvolin, 36; Kernak ..		572
James's Fever Powder. ...		571	Kephalin ..		87
„ Powder, 3 to 6 gr. ..		156	Kephir, 574, 5; Grains, 575, 5; Salieres ..		575
Janet's Method. ...		536	Kepler Malt and Oil ..		572
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			Keratin, 8 gr., and for Pills ..		644

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Kermes Minerale		151	Lactigen, Lactiloids		69
Kernel Oil		144	Lactomaltine, 2 dr.		534
Kerol and Caps.	36 and	344	Lactobacilline, 69; Lactometer,		
Kerocain, 1/5 to 1 gr.		332	451 ; Lactone.. ..		69
„, with Adrenalin Tabs. & Sols.		333	„, Glycogen		70
Kerosene		627	Lactophosphate de Calcium		69
Kharsivan		187	Lactose	805 &	449
Khat, 271; Khomé Seeds		828	Lactuca, Lactucarium, 15 gr. ...		486
Kidd's Strychnine Nitrate Solu- tion		725	Ladanum		804
Kidney Disease Diff. Diag- nosis		368	Ladies' Slipper		794
Kidney Extract		915	Lady Webster's Pills		572
Kidney Permeability Tests		53	Lævopinene		136
Kieselguhr		137	Laevo-Scopolamine		482
Kiliani Test		61	Laibose, 1 oz.		574
Kinazyme Tabs.		924	Laitproto		550
Kinectine		208	Lævulose	687 & 94 ,	405
<i>Kino</i> , 5 to 20 gr.		804	Lake's Lactic Acid Mixture		66
„, <i>Eucalypti</i> 5 to 20 gr.		796	Lambkin's Injections, 10 m.		448
Kineurine, 3 to 8 gr.		43	<i>Lamblia</i>		484
Kjeldahl Estimation		407	Lamb's Wool		437
Kleinenberg's Hæmatoxylin, etc., Stains		390	<i>Lamellæ</i>		523
Klip Dagga		805	Adrenalin, 1-1000 and 1-500 gr.		930
Klondol		36	Alum, 1-250 gr.		134
Knob Root, 791; Wood		831	Atropine, 1-2000 to 1-250 gr.		221
Knorr's Antipyrine		313	„, (<i>Off.</i>) 1-5000 gr.	213,	533
Koko, 572 ; Kola Nut, 10 to 20 gr.		247	{ Atropine, 1-5000 to 1-50 }		213
Kola Wine		572	{ Cocaine, 1-200 to 1-50 }		
Kolentos, 566; Koleradraaber		369	Cocaine 1-100, 1-200 gr. ; (<i>Off.</i>) 1-50; 1/20 gr.	324,	523
Koppeschaar's Solution		2	{ Cocaine, 1-5000 to 1-50 }		217
Koromiko, 804; Koronium Bromide		720	{ Homatrop. 1-5000 to 1-50 }		
Kossam Seeds, 784; Koumiss		574, 5	{ Cocaine, 1-200 gr. }		642
Köttstorfer's No.		143	{ Physostig., 1-1000 gr. }		
<i>Kousso</i> , ¼ to ½ oz.			Eucaine, 1-100, 1-50 gr.		330
<i>Krameria</i> , 804; Kreatinin		395	Gelseminine, 1-500 gr.		424
Krapp Wurzel		819	Homatropine, 1-5000, 1-1000 1-100 gr. (<i>Off.</i>)	217,	524
Krebisote, 3 to 15 gr.		237	Hyd. Perchlor., 1-100,000 gr.		465
Kreochoyle		565	Hyoscine, 1-500, 1-200 gr.		482
Kreosote, 1 to 5 m. incr.		370	Hyoscyamine, 1-5000 gr.		487
Kresapol		36	Iodoform, 1-1000 gr.		494
Kresolum (and Liq.)		32	Lead Acetate, 1-500 gr., and with Opium, 1-250 gr.		
Krönig's Scopolamine-Morphine		483	Morphine (et c. Atrop., 1- 5000), 1-500 gr.	213	544
Kryogenin (<i>vide</i> Cryogenin).			<i>Physostigmine</i> , 1-1000 gr. (<i>Off.</i>) 1-500, 1-250 gr.	524,	642
Krystall Violet, 308, 310 &		354	Pilocarpine, 1-500 gr.		522
Kubel, Litmus Sol.		88	Scopolamine, 1-500, 1-200 gr.		482
Kühne's Carb.-Meth. Blue		539	Silver Nitrate, 1-500 gr.		169
Kukui Oil		804	Thymol, 1-1000 gr.		745
Kurchi		792	Zinc Sulph. (et c. Op. et c. Atrop.) 1-250 gr.		768
Labdanum		804	Lamels, Medicated Gelatin, for use <i>per os</i>		524
Lac Bismuthi, 1 to 2 dr.		227	Laminaria Tents		805
„, „, et Cerii, 1 to 2 dr.		231	Lamplough's Saline		572
Lacca, 823; Lachnanthes		805	<i>Lancæ Adeps</i>		104
Lacmoid, 89 , 170 ; Lacrymal Secretion, 698; Lactase, 69 ; Lactagol, 1 dr., 441; Lacteol		69	'Lancet' Coefficient		342
Lactic Acid Bacilli Cultures, 69; Liq., 72; Curdled Milk, 70 ; Local Use, 73; Suppos. Vaginal, 7 ; Tablets, 69; Uses of		71	Langdon Brown's Mixture, 1 oz.		975
			Lange's Gold Test		395
			Lang's Bottle		214
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Lanolinum Hydrargyri	452	Leucocytosis	382
Lanosol Silver	366	Leukæmia, Blood Counts in	383
Lanthanum .. ..	..	50	Levaseo .. ..	..	573
Lapis Calamin, Præp., 766; Divinus .. ..	..	382	Levigations .. ..	..	749
Larkspur .. ..	..	825	Levisticum Officinale .. ..	..	805
Lappa, 805; Lard .. ..	..	774	Levulose .. ..	..	687
Larix, 648; Lassar's Paste 683, 766		766	Levuretime .. ..	..	273
Lasiosiphon .. ..	..	805	Levurine (and Tab.,) 1 dr. ..	..	273
Latapie Syphilis Test .. ..	..	524	Levy-Bing Lafay Syringe ..	..	449
Lathyrus .. ..	..	805	Libanol .. ..	..	788
Laudanosine .. ..	..	124	Liee, to Kill, <i>see</i> Parasites, Animal, 996, 997; and Trench Fever .. ..	..	529
Laudanum, 5 to 30 m. .. ..	..	608	Lichenoids, 1 or more .. ..	..	789
„ Sydenham's 5 to 20 m. ..	..	608	Liehens .. ..	..	83, 89
Lauri Fruet., Oleum .. ..	..	805	Lieben's Iodoform Test .. ..	..	363
Laurocerasi Folia .. ..	..	145	Liebig's Meat and Malt Wine ..	..	573
Lavandula, 118; Laveran's Stain .. ..	..	535	Ligatures <i>var.</i> .. ..	..	526
Laverain Tabs., 5 or 6 p.d. ..	..	680	Light Green .. ..	..	311
Laville's Remedy .. ..	..	573	Light Treatment .. ..	..	303-305
Lawes' Disinfectant .. ..	..	344	Lightning, Treatment of Stroke ..	..	301
Lawson .. ..	..	150	Lignum Rhodii .. ..	..	813
Laxans .. ..	..	634	Ligroin, 628; for T. Bisolm. ..	..	542
Laxase Tablets .. ..	..	776	Lilac Artificial = Terpeneol ..	..
Laxatol, Laxen, Laxoin, $\frac{1}{2}$ to 8 gr. .. ..	..	634	Lily of the Valley .. ..	..	792
Lawsonia	800	Lime Salts, Administration and t Removal	248 e	seq.
Laxamel	626	„ Estimation	45
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Leamington Wtr.	438	Limonade Purgative, 529; Rogé	529
Lebertran, 592; Leben Raib, 5; Lecanora	89	Limonene, 10 to 20 m.	806
Leeithin, 3-5 gr. (and Powder, 10 to 15 gr., 525), 524 & 87, 450; Cadmium Comp., 88, 94; for Syph. Test .. ..	..	518	Limonis Cort. Succus, 770; Syr. ..	..	806
Leeithin Copper .. ..	..	525	Linet. Ammon. Brom., 1 to 2 dr. ..	..	138
Lecitogen, 3 to 4 dr. .. ..	..	525	„ Apomorphinæ e. Codeina 1 dr. .. ..	..	165
Leehlanche Cell. .. ..	..	271	„ Bart's, 1 dr. .. ..	..	607
Leeches, 914; Leek	778, 822		„ Camph. Co., 1 dr. .. ..	..	607
Lefroy's Crude Oil Emulsion ..	..	628	„ Codeinæ, 1 to 2 dr. .. ..	..	340
Legal's Acetone Test .. ..	..	362	„ Expectorans, $\frac{1}{2}$ -1 dr. .. ..	..	163
Leishmania Infns. Antimony in 151; <i>see also</i> Therap. Index & 492.			„ Gee's, 1 dr. .. ..	..	607
Leishman-Donovan Bodies .. ..	..	492	„ Glycerini, 1 dr. .. ..	..	511
Leishman's Stain and Modifins 385, 386, 499, 535			„ Heroin, 1 to 2 dr. .. ..	..	548
Leistikow's Bougies .. ..	..	171	„ Morph., 1 dr.	544, 545	
Lemco for Media, 558; Meat Wine .. ..	..	573	„ Morph. Hydrocyan, 1 dr. ..	..	545
Lemon Grass, 813; Citral, 114; Juice Vol. I. xxxv 578, 99; Oil, 116; Syrup, 806			„ Opiatus, 1 dr. .. ..	..	607
Lenigallol, 78; Lenirobin .. ..	..	289	„ Pini Terp. Heroin, 1 dr. ..	..	648
Lenitive Eleetuary .. ..	..	693	„ Seillæ, 1 dr. .. ..	..	607
Leonotis .. ..	..	805	„ „ Opiatus, 1 dr. .. ..	..	607
Lentine .. ..	..	418	„ Terp. Pini et Heroin, 1 dr. ..	..	648
Leprosy, Baeillus .. ..	..	493	„ Thymi et Diaphorm. 1 dr. ..	..	828
Leptandrin, $1\frac{1}{4}$ to 2 gr. .. ..	..	805	„ Tolu e. Opio, 1 dr. .. ..	..	607
Leucin	95, 104, 377	Lindenblüthen	491
			Lindley Process	23
			Liniment, A.B.C.	102
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			„ Æruginis	380
			„ Album 647; Ammonia	141
			„ Atropinæ	214
			„ Belladonnæ	223
			„ „ Æthereum	224
			„ Bellad. e. Chlorof.	223
			„ Betulæ Co.	81
			„ Calaminæ 766; Calcis	255

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„ <i>Cantharidis Co.</i> ..		263	„ <i>Auri Hyd. Brom.</i> , 5 to 10 m.		219
„ <i>Capsici (and Dx.)</i> ..		267	„ <i>Bellostii</i> is similar to		
„ <i>Chloral Co.</i> ..		276	<i>Millon's Reagent</i> ..		370
„ <i>Chloroformi</i> ..		286	„ <i>Berberidis Conc.</i> , $\frac{1}{2}$ to 1 dr.		78
„ <i>Crinale</i> 262; <i>Crotonis</i> ..		813	„ <i>Bismuth. Ammon. Cit.</i> , 30-		
„ <i>Hydrargyri</i> ..		451	60 m. ..		226, 42
„ „ <i>Oleat. c. Morph.</i> ..		583	„ <i>Bismuthi Conc.</i> , 15 to 30 m.		227
„ <i>Iodi, syn. Tinct. Iodi</i>			„ <i>Bismuth. Sed.</i> , 1 dr. ..		227
<i>Fortis</i> ..		500	„ „ <i>Tartratis</i> , $\frac{1}{2}$ to 1 dr. ..		237
„ <i>Jaborandi</i> ..		522	„ <i>Bromi</i> ..		414
„ <i>Menthol (& Co.)</i> ..		540	„ „ <i>Arsenitis</i> , 1 to 5 m. ..		176
„ <i>Meth. Salicyl.</i> ..		81	„ <i>Bromo-Chloral Co.</i> , $\frac{1}{2}$ to 2		
„ <i>Myristicæ</i> ..		810	dr. ..		277
„ <i>Opii</i> , 607; <i>Picis</i> ..		652	„ <i>Calcii Chloridi</i> , 15 to 45 m.		258
„ <i>Potass. Iod. c. Sap.</i> ..		661	„ <i>Calcis</i> , 1 to 4 oz. ..		255
„ <i>Salicyl (Methy.)</i> ..		81	„ „ <i>Lactat.</i> , $\frac{1}{2}$ oz. ..		68
„ <i>Saponis</i> ..		690	„ „ <i>Lactoph.</i> ..		60
„ <i>Stokes'</i> ..		647	„ „ <i>Sacch.</i> , 15 to 60 m. ..		255
„ <i>Succini Co.</i> ..		825	„ <i>Calumbæ Conc.</i> , $\frac{1}{2}$ to 1 dr.		
„ <i>Sinapis</i> ..		694	„ <i>Caoutchouc</i> ..		264, 694
„ <i>Terebinth</i> ..		647	„ <i>Carbonis, Deterg.</i> ..		292
<i>Linseed and Oil</i> ..		806	„ <i>Carmini</i> , 40 gr., 1 oz. ..		786
<i>Lintum Ac. Carbol</i> , 5% ..		17	„ <i>Carnis</i> ..		565
<i>Lintum Stypticum</i> ..		410	„ <i>Caulophylli et Pulsatillæ</i> , 1		
<i>Lints</i> 437; <i>Linum Usitat</i> ..		806	to 2 dr. ..		788
<i>Lipase</i> ..		69	„ <i>Chiratæ Conc.</i> , 1 in 2, $\frac{1}{2}$ to		
<i>Lipolytic Ferment</i> ..		70	1 dr. ..		
<i>Liqueur de Labarraque</i> ..		50	„ <i>Chloromorph.</i> , 5-15 m. ..		286
<i>Liquifruta</i> ..		573	„ <i>Cocci</i> ..		786
<i>Liq. Acid. Chromici</i> ..		772	„ <i>Cocainæ HCl. (Inj.)</i> , 5-10 m.		323
„ „ <i>Chrom.-Aceto-Osmici</i> ..		773	„ „ <i>et Antipyrin</i> ..		324
„ „ <i>Hypochlorosi Comp.</i>			„ <i>Copaibæ</i> , $\frac{1}{2}$ to 1 dr. ..		603
(<i>Eusol</i>) ..		51	„ „ <i>c. Buchu et Cubeba</i> ,		
„ „ <i>Osmici</i> , 2-10 m. ..		773	1 to 2 dr. ..		603
„ <i>Salicyl.</i> ..		81	„ <i>Copaiba et Buchu et</i>		
„ <i>Adrenalini Hydrochloricus</i> ,			<i>Cubebæ c. Santal</i> , 1 to		
10 to 30 m. ..		927	2 dr. ..		603
„ <i>Alkalinus Brandish</i> ..		656	„ <i>Cresol Sap.</i> ..		33 & 358
„ <i>Aluminii Acetici</i> ..		134	„ <i>Creosoti</i> , av. 2 dr. ..		371
„ „ <i>Aceto-Tart.</i> ..		135	„ <i>Cuspariæ Conc.</i> , 1 in 2, $\frac{1}{2}$		
„ „ <i>Chloridi</i> ..		135	to 1 dr. ..		
„ <i>Aluminii Formatis</i> ..		135	„ <i>Donovani</i> , 5-20 m. ..		177
„ <i>Ammoniac</i> , 10 to 20 m. ..		141	„ <i>Eastoni pro Syrup.</i> , 418;		
„ „ <i>Domest.</i> ..		141	<i>ditto sine Ferro.</i> ..		418
„ <i>Ammon. Fort.</i> , 3-6 m. ..		141	„ <i>Epispasticus</i> ..		263
„ „ <i>Acet.</i> 2 to 6 dr. ..		142	„ <i>Ergctæ Acet.</i> , et <i>Ammon.</i> ,		
„ „ „ <i>Fort.</i> , '85, 25-			10-60 m. ..		400
75 m. ..		142	„ <i>Ethyl Nitritis</i> , 15 to 60 m.		112
„ „ <i>Anisat.</i> ..		433	„ <i>Euonymin et Cascara</i> , $\frac{1}{2}$ to		
„ „ <i>Aromat.</i> ..		143	1 dr. ..		407
„ „ <i>Cit.</i> , 2 to 6 dr. ..		143	„ „ <i>et Iridin.</i> , $\frac{1}{2}$ to 1 dr. ..		407
„ „ „ <i>Fort.</i> '85, $\frac{1}{2}$ -1 $\frac{1}{2}$ dr.		143	„ „ <i>et Pepsini</i> , $\frac{1}{2}$ to 1 dr. ..		407
„ <i>Antihystericus</i> , $\frac{1}{2}$ -1 dr. ..		782	„ <i>Ferri Acet.</i> , 5-15 m. ..		415
„ <i>Antim. Chlor.</i> ..		26	„ „ <i>Albuminati</i> , 1 to 4 dr. ..		412
„ <i>Antirheumatic</i> , 30 m. ..		341	„ „ <i>et Ammon. Acet.</i> , 4 dr. ..		415
„ <i>Antisepticus</i> , 1 dr. ..		10	„ „ <i>Chloridi</i> , 1 $\frac{1}{2}$ m. ..		410
„ <i>Argenti Nitratis</i> ..		168	„ „ <i>Chlorox.</i> , 10 to 30 m. ..		411
„ <i>Arsenicalis</i> , 2 to 8 m. ..		175	„ „ <i>Dialysat.</i> , 10 to 30 m. ..		411
„ <i>Arsenici Bromatus</i> , 1 to 5 m.		176	„ „ <i>Hypoph. Fort.</i> , 10 to		
„ „ <i>HCl.</i> , 2-8 m. ..		175	30 m. ..		639
„ <i>Arsen. et Hyd. Iodidi</i> , 5 to			„ „ <i>Iodidi</i> , 4 to 8 m. ..		416
20 m. ..		177	„ „ <i>Oxyd. Sacch.</i> , $\frac{1}{2}$ oz. ..		411
„ <i>Atroniæ Salicyl.</i> ..		213	„ <i>Pept. (c. Quin. 414)</i> , 1		
„ „ <i>Sulph.</i> 1%, $\frac{1}{2}$ to 1 m. ..		214	to 4 dr. ..		412

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Liq. Ferri Pept. c. Mang.	..	415	Liq. Quassia Conc., $\frac{1}{2}$ -1 dr.	..	—
„ „ Perchlor., 5-15 m.	..	410	„ Rhei Conc., $\frac{1}{2}$ to 1 dr.	..	—
„ „ „ Fortis, 1 to 4 m.	..	410	„ „ Dulc., 1 to 3 dr.	..	393
„ „ Pernit., 5-15 m.	..	411	„ Rosæ Dulcis	..	600
„ „ Persulph.	..	—	„ Santali c. Buchu et Cubeba,	..	603
„ „ pro Syr. Easton	..	418	1 to 2 dr.	..	603
„ „ Subsulphat., 3 to 6 m.	..	419	„ „ Co., 1 to 2 dr.	..	603
„ „ Tersulphat.	..	419	„ „ c. Kava, 1 to 2 dr.	..	603
„ Ferro-Mang. Pept. 1 to 4 dr.	..	415	„ Sarsæ Co., Conc., 2-8 dr.	..	691
„ Ferro-Mang. Pept. c. Hæmo-	..	415	„ Sedans, $\frac{1}{2}$ to 1 dr.	..	476
globin, 1 to 4 dr.	..	415	„ Senegæ Conc., $\frac{1}{2}$ -1 dr.	..	822
„ Fluoresceinæ	..	635	„ Sennæ Conc., $\frac{1}{2}$ -1 dr.	..	693
„ Formaldehydi (and Sap.)	124,	129	„ Sennæ Dulcis, 1-3 dr.	..	630
„ Fowleri, 2 to 8 m.	..	175	„ Seriparus	..	823
„ Glonoin, $\frac{1}{2}$ to 2 m.	..	558	„ Serpentar. Conc., $\frac{1}{2}$ to 1 dr.	..	50
„ Gutta Percha	..	288	„ Sodæ Chlorinatæ, 10 to 20	..	179
„ Hamamelidis, $\frac{1}{2}$ to 3 dr.	..	443	m.	..	18
„ Helalin c. Pepsin et c. Cas-	..	791	„ Sodii Arsenatis, 2-8 m.	..	698
cara, 1 dr.	..	111	„ „ Carbolatis	..	707
„ Hoffmann	..	460	„ „ Chlorid. Physio.	..	43
„ Hyd. Nitratis Acid	..	462	„ „ Ethylatis	..	33
„ „ Perchlor., $\frac{1}{2}$ -1 dr.	..	462	„ „ Glyceroph.	..	414
„ Hydrogenii Perox., $\frac{1}{2}$ to 2	..	82, 83	„ „ Hydroxidi, U.S., 5 %;	..	825
dr., 477; Acidity, Esti-	..	482	P.G.V., 15 %	..	724
mation Concentration	..	919	„ „ Hypobrom...	..	934
and Preservation	..	500	„ Stillingiæ Co., 1 dr.	..	745
„ Hyoscine HBr., 3 to 15 m.	..	415	„ Strych. HCl., 2-8 m.	..	934
„ Hypophysis, $\frac{1}{2}$ to 1 Cc. in-	..	521	„ Testicularis, 15-30 m.	..	154
tram.	..	415	„ Thymol, 1 in 800	..	783
„ Iodi (Co., U.S., 500),	..	529	„ Thyroidei, 5 to 15 m.	..	558, 94
„ „ Dil., 500; Fortis	..	529	„ „ Assay	..	621
„ Iodo Ferro-Mang. Pept., 1	..	529	„ Tolu pro Syrup	..	786
to 4 dr.	..	544	„ Trinitrini, $\frac{1}{2}$ to 2 m.	..	830
„ Jaborandi, 5 to 15 m.	..	546	„ Trypsin, 1 to 2 dr.	..	764
„ Krameria Conc., $\frac{1}{2}$ to 1 dr.	..	545	„ Unoline, $\frac{1}{2}$ oz.	..	527
„ Mag. Bicarb., 1 to 2 oz.	..	547	„ Violæ Glucosidi, $\frac{1}{2}$ oz.	..	527
„ „ Cit., av. 12 oz. (div.)	..	710	„ Zinci Chloridi	..	527
„ Morphine Acet., 10 to 60 m.	..	558	Liquores Concentrati	..	527
„ „ Bimec, 1.45 %, 5 to 40	..	606	Liquorice, 432, 76; Chocolate	..	527
m.	..	618	Tablets, 433; Compound Pow-	..	527
„ „ HCl., 1 %, 10-60 m.	..	619	der of, 60 to 120 gr. 433;	..	527
„ „ Tart., 1 %, 10-60 m.	..	622	Liquorice (Indian)	..	771
„ Natrii Silicici	..	433	Listerine, 1 to 2 dr.	..	10
„ Nitroglycerini, $\frac{1}{2}$ -2 m.	..	632	Lister's Antiseptic	..	455
„ Opii Sedativus, 5-15 m.	..	631	„ Fumigators	..	125
„ Pancreatis, 1 to 2 dr.	..	292	Litharge	..	654
„ Pancreaticus 1-2 dr.	..	815	„ Lithiated Sorghum Co.	..	824
„ Papain et Iridin, 2 to 4 dr.	..	653	Lithii Aceto-Salicylas, 5 to 15	..	91 & 14
„ Pectoralis, 1 dr.	..	656	gr.	..	776
„ Pepsini et Caffeinæ, 2 to 4	..	176	„ Agaricinas	..	527
dr.	..	175	„ Benzoas, 2 to 10 gr.	..	227
„ Pepticus, 1 to 2 dr.	..	—	„ Bismuth. Cit., 2 to 5 gr.	..	527, 43
„ Picis Ligni	..	51	„ Bromid., 5-15 gr.	..	528
„ Picrotoxini, 2 to 12 m.	..	144	Lithii Carb., 2 to 5 gr.	..	528
„ Plumbi Lactat.	..	418	„ Citras, 5 to 10 gr., 528;	..	528
„ Plumbi Subacet., Dil., Fortis	..	—	Effervesc. (and Lax.	..	528
„ Potassæ, 10 to 30 m.	..	144	U.S.), 1-2 dr.	..	39
„ Potass. Arsenat. et Bromid.,	..	175	„ Formas, $\frac{1}{2}$ to 2 gr.	..	43
1 to 5 m.	..	528	„ Glyceroph., 3-10 gr.	..	528

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Lithii Sulphas., 5 to 10 gr. . .		528	Lotio Plumbi Spirituos . .		654
„ Sulpho-Ichthyolas, 10 to 30 gr. daily . .		488	„ „ Talc et Amyli . .		654
„ Tart. Acid., 5-20 gr. . .		528	„ pro Acne . .		767
Lithion, $\frac{1}{2}$ to 1 dr. . .		528	„ Quassia . .		818
Lithium . .		527	„ Quininae HCl. . .		668
„ Diuretin, 5-15 gr. . .		737	„ Resorcini (and Co.) . .		682
Lithol . .		488	„ „ et Ac. Borici . .		683
Litmus Paper, Solutions, 88, 170; Broth, Milk . .		559, 560	„ „ et Acid Salicyl . .		682
Liver Abscess . .		513, 495	„ „ Pilocarp. et Canth. .		682
„ of Sulphur . .		656	„ Rubra . .		768
„ Desicc., 5 gr. incr. . .		915	„ Sulphatum . .		768
„ Extract, 20 Cc. . .		915	„ Sulph. c. Sapone . .		730
„ for Syph. Test . .		517	„ Zinci Chloridi . .		764
Livingstone Rousers . .		678	„ „ Sulphatis . .		768
Lobelia . .		806	„ „ Sulphid . .		768
Lockyer's Hair Restorer . .		573	Lotion Ammoniacale Camphrée		258
Locock's Wafers . .		573	Lovage, 805; Loewenthal's Serum . .		932
Locke's Solution . .		698	Lowndes Cream; <i>vide</i> Cremor Lowndes . .		
Lodal, 1 gr. . .		549	Lozenges, Bases for, 749; see also Trochisci . .		
Locflier's Meth. Blue . .		539	Luargol . .		207
„ Serum . .		561	Lubricant Glyc. Jelly . .	428 &	459
„ Pigment (Diph.) . .		410	Lubricant Surgical . .		16
Loewi's Test . .		153	Lubricating Oils . .		627
Loewi's Theory . .		255	Ludyl, 0.4 to 0.6 Gm. . .		209
Logwood . .		790	Luetin . .		515
London Water . .	418, 427,	432	Lugol's Solution = Liq. Iodi, '85, 5 to 10 m. 500, 556; Conc. 439		
Lonicera <i>var</i> . .		806	Lumbar Anæsthesia . .		336
'Lords and Ladies' . .		781	Lumbricus, 688 and Therap. Index . .		
Lotio Acid. Acetici . .		3	Luminal, $1\frac{1}{2}$ to 5 gr. 757, 245 & Chart		
„ „ Benzoic . .		6	„ Sodium (20% Soln. Hypod.) 2 to 3 Cc. . .		758
„ „ Borici, 4% . .		11	Luminous Paints . .		316
„ „ „ c. Zinc Sulph. . .		11	Lunar Caustic, 167; Mitigated Toughened . .		169
„ „ Carbolici (et c. Cocaina) . .		16	Lund's Oil . .		16
„ „ Citrici et Phenolis . .		32	Lupulin (Lupulus), 2 to 5 gr. . .		806
„ „ Hydrocyan. c. Sodio . .		49	Luteolin . .		61
„ „ Picric., 1% . .		76	Lycoperdon Gig. . .		807
„ Ætheris Compositus . .		111	Lycopodium . .		807
„ Ammonii Chloridi . .		139	Lycryl . .		36
„ Balsami Peruvian . .		782	Lyddite . .		75
„ Boeck . .		654	Lymph, Calf, Glycerinated . .		903
„ Calaminæ (Oleosa 767) . .		766	„ Serum . .		932
„ Calcii Sulphurat. . .		256	Lymphatic Gland-Tabs., 5 gr. .		915
„ Calc. Iodat., 65; Capillaris .		682	Lymphoid Compound Caps. . .		932
„ Creolin, 35; Evaporans 122, 139		682	Lysin . .		516
„ Excitans . .		682	Lysoform, 128; see also Formosyl		
„ Hyd. Acetica 464; Biniodidi, 456; Flava, 462; Nigra, 471; Perchlor., 464; c. Acid. Carbol, 464; et Zinci Cyanidi . .		456	Lysol . .		34, 36
„ Krameria Co. . .		6	„ Martindale . .		35, 354
„ Pancreatis . .		621	Lytta, $\frac{1}{16}$ gr. . .		261
„ Paraffini Co. . .		629	McBride's Treatment . .		211
„ Parasiticidus . .		464	McConkey's Broth . .		423
„ Picis Carb. Alk. Arom. . .		292	„ Neutral Red Lactose Agar 838 & 423; Bile Salt Agar . .		423
„ Pilocarpinae (hair) . .		522	McCrorie's Stain . .		548
„ Plumbi Detergens . .		292	McDade's Succus, 1 dr. . .		825
„ „ Evaporans . .		654			
„ „ et Opii, 654; Solubes. . .		654			
„ „ Lact. . .		653			

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McDonagh's Syphilis Test	..	528	Malaria, Relapses, 674; War Ex-		
Ferrivine Intramine,			periences	673,	497
etc. . .	413,	73	„ Quinidine & Cinchonidine		
McDougall's Fluid	..	344	in . . .	140	
Mache Unit	..	319	„ Quinine in	664, 667, 669, 673,	
Macintosh Sheeting	..	265	et seq., 867, 868 & 141,	497	
Mackenzie's Cure, 573; Eye-			„ Types and Parasites, 498,		
wash	..	464	499; Cultivation	500	
MacLagan's Test	..	57	„ Staining Methods	499	
Madder	..	819	Male Fern (Caps.)	..	420
Magenta, $\frac{1}{2}$ to 4 gr., 308; Acid		539	Malfatti's Processes	..	374, 409
Magisal, 5 to 15 gr.	..	91	Malignant Edema	..	500
M.L.D.=Minimum Lethal dose,			Malignant Purpuric Fever	..	849
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Magisterium Bismuthi.	..	231	Mallein	..	488
Magma Bismuthi, 1 dr.	..	229	Malonal, Malonurea, 5 to 10 grs.	753	
Magnesia Cream, 1 to 4 dr.	..	530	„ Identification	246 & Chart	
„ Mixture	..	90	Malt, 532; Assay of	..	90
Magnesia Levis and Pond., 30			„ Experiments to determine		
to 60 gr., 5 to 20 gr. rep.	..	529	Incompts. with	533 & 91	
Mag. Aceetyl-Salicyl, 5 to 15 gr.	..	91	„ Extract, 1 to 4 dr.	..	532
„ Benzoas, 5 to 15 gr.	..	7	„ and Cascara, 1 to 4 dr.	..	534
„ Borocit, 15 to 30 gr.	..	12	„ „ Hæmoglobin, 1 to 4 dr	534	
„ Bromid., 10 to 20 gr.	..	238	„ „ Hypophosph. (and		
„ Cacodylas, $\frac{1}{4}$ gr.	..	181	with Oil), 1 to 4 dr.	534	
„ Carb. Levis, Pond., 30 to			Malta Fever	500	
60; 5 to 20 gr. rep.	..	529	Maltaffin and combinations, 1 to		
„ Chaulmoograte	..	592	2 dr. . .	533	
„ Chloras	..	530	Malted Glyceroph., 1 to 4 dr.	..	45
„ Chloridum, 30 gr. or more	530		Malti Pulvis, 1 to 2 dr.	..	532
„ Citras Ver., 30 to 120 gr.	..		Maltine and Preps., 1 to 4 dr.	..	533
„ Formas, 3 to 10 gr.	..	39	Maltoferrosc, 1 to 4 dr.	..	534
„ Glyceroph., 3-10 gr.	..	43	Maltolivine, 2 to 4 dr.	..	596
„ Hydrox., 5 to 120 gr.	..	530	Maltose Agar	..	560
„ Hydrox., c. Carbone, 1 to			Malva, 491; Mamiran.	..	792
2 dr.	..	530	Malvern Water	..	438
„ Hypochlorite	..	59	Manaca, 807; Mandelin's Test	..	174
„ Hypophos., 3-10 gr.	..	639	Mandl's Pigment	..	501
„ Lactas, 15 to 60 gr.	..	530	Mandrake, 807; Amer.	..	655
„ Oleas	..	587	Manganese Colloidal	..	358
„ Peroxid., 15 to 60 gr.	..	480	Mangan. Brom., 1 to 3 gr.	..	238
„ Pyrophosphas	..	90	„ Citras, 3 to 5 gr.	..	535
„ Ricinoleas, 1 to 4 dr.	..	599	„ Ferro Phosph., 3 to 10 gr.	..	535
„ Salicyl, 10 to 30 gr.	..	82	„ Glyceroph., 1 to 5 gr.	..	43
„ Silicas	..	137, 90	„ Hydrat. Colloid	..	349
„ Sulphas, $\frac{1}{4}$ - $\frac{1}{2}$ oz.; 30-90			„ Hypoph., 1-10 gr.	..	535
gr. rep.	..	531 & 358	„ Ox. Præcip., 3-10 gr.	..	535
„ Sulphas Eff., $\frac{1}{2}$ -1 oz.; 60-			„ Phosph., 1 to 5 gr.	..	536
180 gr. rep.	..	532	„ Sulph., 2 to 10 gr.	..	536
„ Sulphas Exsicc.	..	532	Manna, 1 dr. to 1 oz.	..	807
„ Sulphate Cream	..	532, 150	Manilla Grain	..	780
„ Sulphis, 10 to 30 gr.	..	98	Mannitol (Syn., Mannite)	..	807
Magnesium	..	529 & 90	„ Nitrate Tabs., 1 gr.	..	402
Maguey	..	817	Manometers	..	388
Magnetic Felds	..	302	Manures, Artificial	..	41
Maidis Stigmata, 807; Ustil-			Maran (W. Indies)=Bals. Co-		
lago, 807; Maize Ergot, 807;			paibæ	..	
Maize, 105; Oil	..	807	Marchi Reaction	..	380
Majax	..	574	Margarine 451, 456; Mariani Wine	573	
Malachite Green	..	308	Margosa Seeds	..	782
Malabar Fibre	..	527	Maricol, 1 to 4 dr.	..	599
Malaria, 867, 991; Etiology,			Marienbad Salt and Tabs., 60gr.	712	
495; in England, Meas-			„ Tab. (vegetable)	133	
ures against, 675, 495;			Antiobesity Tabs.	..	712
			Marigold=Calendula	..	785

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Marjoram.	813	<i>Menthol</i> , $\frac{1}{2}$ to 2 gr.	539, 120
Marmite	99, 468	„ Camphora et c. Phenol	539
Marrow, Glyc. Ext.	912	„ Paraffin Caps	540
Marrubin, 1 to 2 dr.	912	„ Plaster	540
„ Compounds	912	„ Snuff, 541; . Spray;	541
Marrubium, av. 30 gr.	807	„ Wool, 540; Valerianate	541
Marsh Mallow, 491, 778; Pastils, 429; Marsh's Test	31	Mentholeate, 540; Mentho-Phenol.	539
Marylebone Cream	579	Menyanthes	809
Marza Wine	573	Mercaptan	726
Massicot	654	Mercurettes	451
Mastiche	807	Mercurial Cream, 10 m.	449
Mastich Leaf Oil.	808	„ Injections Intrav.	450
Mastisol	808	„ „ Summary	450
Maté	248, 44	Mercurialised Serum	467
Mather's Fly Papers	174	Mercuric Ammon. Chloride	452
Matricaria Chamomilla	780	„ Benzoate, $\frac{1}{50}$ to $\frac{1}{10}$ gr.	453
Maubeere, 819; Mauve (Malva)	491	„ <i>Biniodide</i> , $\frac{1}{32}$ to $\frac{1}{16}$ gr.	456
Mauveine HCl.	455	„ Iodide Soaps, 459; Wool	457
May Apple	655	„ Nitrate Ointment	460
May-Grunwald Stain	388	„ Oleate and Comps.	583
Mayer's Carmine, etc., Stains.	390	„ Oxide Yellow, 472; Red	473
„ Phenolphthalin	„ Oxysulph.	472
„ Blood Test	379	„ Potass. Iodide, 1/16-1/4 gr.	458
Mayer's Reagent	80	„ Rhodanide	474
Meadow Saffron	341	„ <i>Vide also Hydrarg.</i>
Measles, 940, and Therap. Index	940	Mercurius Dulcis.	469
Meat Extracts, 563, 97 ; Juice	564	Mercurochrome " 220 "	80, 358
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Meconin Morphine Narcotine Comp.	550	Mercury Amalgam	452
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ride	..	539
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-protocatechuic Alde-	..	
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Resorcin	..	406
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-Salicyl (Plaster 81), 5 to	..	
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-Theobromine	..	243
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Microbene	..	37
Micrococcus Catarrhalis	..	846
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Microcosmic Salt	..	709
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Mist. Ac. Aceto Salicyl, $\frac{1}{2}$ oz.	..	88
Ætheris, c. Ammon., $\frac{1}{2}$ oz.	..	111
Agrimoniæ Co., $\frac{1}{2}$ oz.	..	776
Alba, $\frac{1}{2}$ to 2 oz.	..	532
Ammoniæ, $\frac{1}{2}$ to 1 oz.	..	
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Moss Accouchement Sheets, Compressed Sheets, Dressings Loose, Felt, Gauze-Covered Towels, Pillows, Sterilisation ..		716	Myrosin, 144, 69; <i>Myrrh</i> , 5 to 15 gr.		810
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.. .. Plant		812	Myrtus Chekan		789
.. .. to ward off		495	Mystin		452
.. .. and Bites and Stings ..		964	'N.C.I.'		553
Moss, Irish		790	Nabarro on Tick Fever		529
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Molybdenum, 420; Molybdenite ..		420	Nagelschmidt's app.		302
Motenol		291	Naphthalene, 2 to 15 gr. ..		553
Mountain Ash 824; Damson ..		823	.. Tetrachlor. (HCl.), 3 to 12 gr.		554
Mouth Washes, 128; Permang., 537; Peroxide		478	Naphtha Mineral	121, 627	
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<i>Mucilage Acacæ, ad lib.</i>		771	.. B-, 3 to 10 gr.		551
.. Amyli, 12 gr. to 1oz. - ..		230	.. Benzoate		552
.. Bismuthi		793	Naphthol Bismuth, 10 to 30 gr. ..		236
.. Cydonii		772	.. Charcoal, 552; Salicyl ..		553
.. <i>Gummi Indici</i>		748	Naranja, F.E. = Aurantii Amaræ Cortex		811
.. Marantæ		820	Narceina, 1-8 to 1 gr.		549
.. Salep		816	Narcotic Drugs Combinations ..	944, 953	
.. Psyllii		826	Narcotic Drugs Order		554
.. Symphiti		748	Narcotina, 1 to 3 gr.		550
.. <i>Tragacanthæ</i>		829	.. Morphine Meconate, $\frac{1}{3}$ to $\frac{1}{2}$ gr.		275
.. Ulmi, 4 dr.		271	Narcyl, 1 gr. p.d., 811; Nargen-tol, 275; Nargol		265
Mucogene Caps., 2 to 3		916 & 367, 462	Nasal Douches (et v. Collunaria) ..		238
Mucin. 5 to 10 gr.		421	.. Bougies		497
Mucuna Pruriens, 1 to 2 gr. ..		810	Nascent Iodine		489
Muirapuama		830	Nasgar Medium		824
Mulberry Juice, 809; Mullein, Great		558	Nastin (Benzoyl Chloride prepn.) 494; Natto		563
Müller's Fluid Formol		128	National Insurance Act.		
.. Trypsin Test		696	Natrium, see Sodii		
Mulls, Adepsine, Anserine, 550; Thiosinamin		574	Nativelle's Digitaline Granules ..		390
Mumps, 940; Munyon's Preps. ..		415	.. .. Solution, 1 Ce.		390
Murexide		5, 776	Naulheim Baths, 252; Salts		710
Muscarine		560	Neatsfoot Oil		85
Musgrave's Medium			Nebulæ		555
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Musk (and artif.)		810	.. Acid Lactic		67
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Muslin, 437; Mustard		1023, 458	.. Alkalina	555, 704	
Mustard Gas		476	.. Aluminis, 5 to 15 gr. to oz. ..		555
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Muthu's Inhalants		564	.. Antiasthmatica		555
Mutton Bird Oil, 595; Essences ..		37	.. Antipyrini		555
Mycetol .. ..			.. Antiseptic		555
Mycoslysine Extract, 2 to 3 dr., Injection, 10 to 40 Cc., sub-cut., Liq., $1\frac{1}{2}$ to 2 ozs		916	.. Astrigent, 555; Catarrh ..		324
Mydriazine, 215; Myelin		912	.. Cocainæ HCl.		555
Myelocne, 10 drops or more		262	.. Cocainæ Co.		320
Mylabris sp.		784	.. .. Oleosa		555
Myrica Acris, 120; Myrica Gale ..		810	.. Creosoti Co., 556; Cupri Sulph.		555
Myricin, 2 to 5 gr. Diphteria		330
			.. Eucain HCl.		406
			.. Eucalypti, 555; Co.		

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„ Ferri Perchlor	..	410	New Skin	..	344
„ Formaldehyd. Muthu	..	127	Niccolum and Salts	..	811, 150
„ Hay Fever.	..	555	„ Carboynyl	..	458
„ Hydrarg. Nit.	..	461	Nicholson's Blue	..	1
„ Iodoformi, 40 gr. to oz.			Nicolle's Gono. Vacc.	..	862
„ Ether	..	..	Nicotina, 1/6 to 1 gr., Salicylas	..	812
„ Iodi Co., 556; Lobeliæ			„ Tartaras..	..	358
„ Co.	..	555	Niggerhead	..	794
„ Menthol (Co., 556)	..	540	Night Blue	..	311 & 548
„ Phthisis, 556; Pini Co.			Nightshade, Deadly	..	220
„ (et c. Cocaine)	..	556	„ Black, Woody	..	823
„ Potass. Chlor. c. Ferro	..	556	Nikalgin, 5 to 15 gr.	..	670
„ Potassii Permang.	..	555	Nilicamam	..	795
„ (Potass. Permang. 1 gr.,			Nim	..	782
„ Sodii Chloridi, 5 grs.,			Ninhydrin	..	375
„ Water to 1 oz)	..	556	Niobium..	..	827
„ Quinin. Antiseptica	..	556	Nisbet's Specific	..	602
„ Resorcini	..	555, 683	Nissl's Stain	..	490
„ Sodii Bicarb.	..	704	Niton	..	318
„ Sodii Salicyl, 20 gr. to oz.			Nitre, 661; Nitrated Papers	..	662
„ Aq.	..	..	Nitric Acid from the Air	..	45, 150
„ Stimulant	..	556	(See also Ac. Nitric.)		
„ Suprarenal	..	555, 925	Nitrifying Bacteria	..	557
„ Tonic	..	556	Nitrite { ½-1 m. by mouth 2-5 m. }		
„ Zinci Chlor. vel Sulph., 10			of Amyl { inhaled	..	146
„ to 25 gr. in oz.	..	555	„ Sterules	..	146
„ „ Sulphocarb., 5 gr.			Nitrobenzol	..	302, 25, 33
„ to oz.	..	..	Nitro-celluloses	..	343
„ See also Vapores.			Nitro-erythrite, ½ to 1 gr.	..	401
Nectandrine, 784; Neelsen's			Nitrogen..	616 & 557	
Sol.	..	539	„ Estn. in Urine	..	408, 409
Neem, Nim = Azadirachta I.C.			„ 'Factor'	..	463
Add.	..	782	„ Fixation	..	45, 150
Neisser's Bacterin, 860; Bougies,			Nitrogen Peroxide	..	1023 & 106
171; Stains	..	479	Nitroglycerin, 1-200 to 1-50 gr.;		
Nelli	..	795	„ incr.	..	556
Neo-arsenphenolamine..	..	205	„ Assay of	..	94
Neocaine	..	339	„ Solution, ½-2 m. incr.	..	558
Neodymium	..	50	„ Tablets, 1-600, 1-400,		
Neopine	..	124	„ 1-200, 1-100, 1-75, 1-50		
Neokharsivan	..	205	„ & 1-25 gr., also ½ and 1		
Neon	..	313	„ mgr. 559, et seq. (See		
Nephelometric Estimation of			„ also Tabellæ)		
Quinine in blood and urine	..	52	Nitro-mannite, 1 gr.,	..	402
Nephritis	..	993	Nitrometer, Allen's	..	26
„ Filter passing virus in.	..	994	Nitropropiol	..	404
„ Interstitial and Paren-			Nitroso-Nitrate of Mercury	..	370
„ chymatous, Diff. and			Nitro-toluene (o. & p.)..	..	335
„ Diagnosis	..	368	Nitrous Oxide, 139, with ether,		
„ Urea per os in	..	368	„ 108; Nitrous Oxide and Oxy-		
Neo-Salvarsan	..	205	„ gen, 140; Nizin	..	301
Nepenthe, 5 to 20 m.	..	608	Noguchi's Diagnosis Methods	515, 523	
Nernst Lamps, 50 ; Neroli Oil..	..	218	Nopalea, 786; Nordhausen Acid	..	98
Nesfield's Sterilising Tablets	..	420	Normal Horse Serum	..	895
Nessler's Solution	..	417	„ Saline Solution	..	697
„ Modified	..	438	Normyl Treatment	..	574
Nettle, 38; Neuralgic Pills	..	242	Notification of Infectious Dis-		
Neuralgic Powders, 16 gr.	..	244	„ eases	..	940
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Staining Solution	..	490			

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Novaspirin, 86; Novaspirinoids		86	Oleo Copaibæ		602
Novarsenol		205	„ Cubebæ, 5-30 m. ..		378
Novocain, 1/5 to 1 gr. ..		332	„ Piperis, Av. ½ gr. ..		815
„ Identification		57	Oleosaccari, F. Ital., <i>q.v.</i>		
„ -Suprarenin		333	‘Oleum’		98
„ with Strychnine		334	<i>Oleum Abietis</i>		648
Nourry's Iodinated Wine		501	„ Acidi Salicylici		82
Nuclein, Nucleol, 15 gr. ..		274, 94	„ Adipis = Lard Oil.		
Nucleo-proteins		94, 367	„ <i>Ajowan</i> , ½ to 3 m. ..		743
Nucoline		750	„ Allii Essent., ½-1 m. ..		777
Nulomoline		687.	„ <i>Amygd.</i> , 144; Sterilisat. ..		145
Nutmeg, 810; Nutrimenta		562 & 94	„ „ Ess. (et <i>s.</i> HCN) ..		144 & 25
Nutri nt Media		559	„ „ Persicæ		144
Nutrient Powder, Brand's		566	„ <i>Anethi</i> , ½ to 3 m. ..		780
Nutrose		425	„ <i>Anisi</i> , ½ to 3 m. ..		780
<i>Nux Vomica</i> , 1 to 4 gr. ..		579 & 111	„ Anseris		550, 749
Nyctal, 5 to 15 gr.		756	„ <i>Anthemidis</i> , ½-3 m. ..		780
Nylander's Reagent		404	„ Apii, ½ to 3 m.		164
Nyrdahl's Deagees		802	„ <i>Arachis</i>		780, 120
Oak Agaric, 778; Oak Bark		818	„ Aseptic		145
Ocymum		812	„ Atropinæ		215
Oenanthe Crocata		815	„ Aurantii Dulcis, 217; with		
Ogle's Drops, 1 dr.		545	„ Ether		108
Ohm's Law		271	„ „ Terpenecless.. ..		218 & 39
Oidium Albicans		455	„ Bergamot		119
Oil Sterilised, 145; of <i>Lemon</i>			„ <i>Betulæ</i> , 5 to 15 m., 80;		
„ <i>Grass</i> , 813; of Mirbane, 302;			„ Pyrolig.		652
Tar		651	„ <i>Cadinum</i>		652, 137
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Oil of Orange in Anæsthesia		108	„ <i>Cajuputi</i> , ½-3 m. ..		785
„ Vitriol		97	„ Camphoræ Essent. ..		257
„ <i>Wintergreen</i>		80	„ Camphorat.		257, 258
Oil Ether Anæsthesia		110	„ Carbolicum		16
Oils, Iodine, Nos. of		85	„ <i>Carui</i> , ½ to 3 m. ..		787
„ Essential, Antiseptic power			„ <i>Caryoph.</i> , ½-3 m. ..		787
„ of		581 & ..	„ Cassiæ, ½-3 m. ..		291 & 52
„ Saponification Nos. ..		143	„ Cedri var.		788
„ Terpeneless		112	„ Celery, ½ to 3 m. ..		164
Oiled Calico, Silk, etc. ..		265	„ <i>Chaulmoogra</i> , 5-10 m.		
Oiled Silk Dextrinised ..		266	„ incr.		587
Oiled Silk Protective		265	„ Chenopodii, 3 m. ..		790
Oils, Alkaloidal		599	„ Cinereum		449
Ointment Bases mps.		252	„ <i>Cinnamomi</i> , ½ to 3 m. ..		291 & 52
Ointments, sec Mulls and Un-			„ Citri		118
guenta.			„ Citron		119
Okol. See Sanitas Okol.			„ Citronellæ		52
Olea Essentialia		581 & 112	„ <i>c.</i> Cocaina, 2%		320
„ „ ‘T’ & ‘S’ free ..		112	„ Cociois Nucif		96, 749
„ „ Indian		114	„ <i>Copaibæ</i> , 5 to 20 m. ..		602
Olea Europœa, 595; Oleano-			„ <i>Coriandri</i> , ½-3 m. ..		792
dyne		582	„ <i>Crotonis</i> , ½ to 1 m. ..		812
Olcata, 581; Prepn. of ..		582, 585	„ Croton Elliott, 1 to 3 m.		813
Oleatum Aconitinæ, 1 in 50		104	„ „ Caps., ½ m., two to		
„ Atropinæ		215	„ 5		813
„ <i>Hydrarg.</i> , 5 to 25% ..		583 <i>et seq.</i>	„ <i>Cubebæ</i> , 5 to 20 m. ..		378
„ „ <i>c.</i> Morph.		583	„ Dugong		595
„ „ <i>c.</i> Sulph.		583	„ ‘Elliott,’ 1 to 3 m. ..		813
„ Morphinæ, 1 in 60 ..		543	„ Erigeron, 5 to 30 m. ..		795
„ Veratrinæ, 1 in 50 ..		762	„ Eserinæ		599
Olcogen, Camphor, 20%, Guaia-			„ <i>Eucalypt.</i> , ½-3 m. ..		403 & 71
col 20%, Ichthyol 10%, Iodi			„ Fagi Pyrolig.		652
5 and 10%, Menthol 2%,			„ Foeniculi, 5-15 m. ..		797
Salicyl. 10%		629	„ <i>Gaultheriæ</i> , 5 to 15 m. ..		80
Oleo-res Aspidii, 30 gr. ..		420			
„ Capsici		266			

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Oleum Gossyp. Sem. . .		257, 120	Oleum Rosmarini, $\frac{1}{2}$ to 3 m. . .		12
„ Graminis Cit. . .		813	„ Rusci Pyrolig. . .		65
„ Gynocardia, 5 to 60 m. . .		587	„ Sabinæ, 1 to 4 m. . .		82
„ Hedeomæ . . .		816	„ Santali, 5 to 30 m. . .		600 & 12
„ Helianth. . .		597	„ Sassafras . . .		82
„ Homatropinæ . . .		216	„ Sesami . . .		603, 12
„ c. Cocaina . . .		216	„ Sinapis Ex. & Volatile, . . .		694 & 14
„ Hyd. Biniodidi, 1 Cc. . .		457	„ Soya . . .		568, 597, 82
„ Hyoscinae . . .		482, 599	„ Staphisagriæ . . .		82
„ Iodoformi et Creosoti . . .		492	„ Succini, 1 to 5 m. . .		82
„ Jecoris . . .		592	„ Tea Seed . . .		12
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„ „ Ligni, 803; Pyro- lig. . .		652	„ Terebinthinæ Rect., 2 to 10 m. as Anthelmintic, 3 to 4 dr. . .		646 & 13
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Picro-Saccharometer		405	„ Co., 1 a. cib. ult. ..		13
Picrotoxinum, 1/100 to 1/25 gr.		815	„ Strych. et Bellad. ..		13
Pigment Acidi Picrici et Camph.		76	Aloin, $\frac{1}{2}$ gr.; Podoph., $\frac{1}{2}$ gr.,		
„ „ Tannici		427	Ext. Cascara, 1 gr., Ext.		
„ Antiseptic		17	Bellad., $\frac{1}{2}$ gr., Oleores.		
„ Argent Nit. Æther		169	Capsici, $\frac{1}{2}$ gr.		
„ Camphoræ Chloral et Men-			Alterativa S.H.:—		
thol		259	{ Pil. Hyd., 2 gr. ... }		
„ Casein		576	{ Pil. Rhei. Co., 3 gr. }		
„ Chloral Camph. et Co. ..		276	Aluminii Chloridi, 2 gr. ..		13
„ Chrysarobini, et c. Pyro-			Antidipsom:—		
gallol		288	{ Strychnine, 1/60 gr. }		
„ Cocainæ et Hydrarg. ..		327	{ Atropine, 1/200 gr. }		
„ contra Tineam		464	{ Quin. Sulph., 2 gr. }		
			Antimonii Conii et Quin. ..		15
			Aperiens = Hyd. Col. Ipec. et		
			Hyos. “78” U.C.H. ..		

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Pilulæ—			Pilulæ—		
Argent. Cyanidi, 1/60 gr. . .		167	Codeinæ Valerianæ Co. . .		340
„ Nit., 167; et c. Morph.,			Colchicinæ, Hyosc. et Nuc.		
$\frac{1}{8}$ gr.		169	Vom.		342
Arsamin, $\frac{1}{2}$ gr.		184	Colocynth. Co., 4 to 8 gr. . .		367
Arsenicalis, 1/120 to 1/20 gr. .		176	„ et Hyos., 4 to 8 gr. . .		367
„ et Strych., 1/50 gr. . .		176	„ c. Ipecac. Aperient,		
Arsen. Hyd. Iodid.		177, 457	= U.C.H., '78':		
Arsen. Ferri et Hyd. Iod., 1 or 2		457	Emetine Bism. Iodide, 1, 2		
Asafetid. Co., 4 to 8 gr. . .			and 3 gr., <i>Salol</i> , <i>et d.</i> . .		519
Asiaticæ, 1 or 2 daily . . .		176	Ext. Hyoscy., 1 gr., Ipecac.,		
Atropinæ, 1/120 to 1/60 gr.,			$\frac{1}{8}$ gr.		
1 <i>h.s.</i>		215	Pil. Col. Co., 2 gr. Pil.		
„ Arsen., et Quin.		215	Hyd. $1\frac{1}{2}$ gr.		
Baillie.		389	Compound Bismuth.		234
Belladonnæ, Nucis Vom. et			Coninæ HBr., $\frac{1}{2}$ gr.		368
et Cannabis Ext., $\frac{1}{2}$ gr. each		223	Convallariæ Ext., 2 to 8 gr. .		792
Beta-Naphthol, 3, 5 gr. . . .		552	Cresoti, 1 in 2, 2-6 gr. . . .		372
Bismutho-Sodii Sal. cum Salol		234	Crocq., 169; Cupri Acet., $\frac{1}{8}$ gr.		380
<i>Blaud's Ferrug.</i> 5 to 15 gr. 408		72	Cynoglosse Opiacées.		794
Butyl Chloral, 3 gr.		242	Damianæ Co., 1 <i>t.d.</i>		383
{ „ Hydr., 3 gr. . . . }		242	Digitalis Fol., $\frac{1}{2}$ gr., 1 <i>t.d.</i>		
{ Gelsemininæ HCl., 1/200 gr. }			„ Opii et Quin. (Heim's):—		
Butyl Chloral 2 gr., Camph.			Digitalis, $\frac{1}{2}$ gr.; Ipecac.,		
1 gr., Ext. Gelsem. $\frac{1}{4}$ gr. . .		242	$\frac{1}{4}$ gr.; Opii, $\frac{1}{4}$ gr.; Quin.		
Caffeinæ, 1 to 5 gr.		243	Sulph., 1 gr.		
Caffeinæ Triodidi Comp.,			„ Co., St. G. H.		389
<i>s.t.d.</i>		246	Digitoxin, 1/250 gr.		391
Calcii Chloridi, 5 gr.		248	Diureticæ S.H.:—		
„ Permang., $\frac{1}{4}$ to 2 gr. 538.		701	Pil. Hydrarg. Pulv. } <i>a.a.</i>		
Calc. Sulph., 1/12 to 1 gr. . .		256	Scillæ Pulv. Digital. } 1 gr.		
Camphoræ		259	Donovani		177, 457
„ Monobrom., 3 gr.		259	Dupuytren		464
„ Salicyl., 1 to 5 gr.		260	Easton's (et c. Arsen., 1/60		
Capsici Co.		266	gr.), 2 or 3 daily		418
Cascara Ext., 2 gr.			Elaterii Co.		795
„ Co., 1 <i>h.s.</i>		270	Ergotini, 1, 2 or 3 gr.		398
Cathartic Co., U.S.:—			Ergotin, gr. 3; Strychnine		
Ext. Col. Co., 2 $\frac{1}{2}$ gr.; Gam-			Sulph., gr. 1/64; Ext. Can-		
boge, $\frac{1}{2}$ gr.; Hyd. Sub-			nab. Ind., gr. $\frac{1}{8}$ (Owen		
chlor., 2 gr.; Jalap Res.,			Lanckester).		
$\frac{3}{4}$ gr., approx. in 2 pills			Euonymin, 2 gr.		406
for av. dose.			Euonymi Co.. Bart's.:—		
Cathartic Co.; Vegetabiles			Ext. Euonymi, 1 gr.;		
U.S. viii.:—			Ext. Aloes, $1\frac{1}{2}$ gr.; Ipecac.,		
Ext. Col. Co., 2 gr.; Ext.			$\frac{1}{2}$ gr.; Ext. Hyoscy 1 gr.		
Hyoscy., 1 gr.; Jalap			Exalgin, $\frac{1}{2}$ to 2 gr.		2
Res., $\frac{3}{4}$ gr.; Leptandra			Ext. Bellad., $\frac{1}{8}$ gr., $\frac{1}{8}$ gr., $\frac{1}{4}$ gr.		
Ext., $\frac{1}{2}$ gr.; Podoph.			Ext. Filicis, 3 m.		421
Res., $\frac{1}{2}$ gr.; Peppermint			Ext. Nucis V., $\frac{1}{4}$ gr., $\frac{1}{4}$ gr.,		
Oil, $\frac{1}{4}$ m., in 2 pills for			$\frac{1}{2}$ gr., Salol, 2 or 3 gr. (Mayo		
av. dose.			Robson).		
Cerevisæ Ferment <i>vide</i> Fæxin.			Extr. Cannab Ind., $\frac{1}{4}$ to 1 gr.		261
Champ. ey. <i>Syn.</i> Pil. Hydrarg			Fæxin Ext., 3 gr.		274
Perchlor. Co. Barts. Mer-			Fel Bovini et fœnugræci. . .		407
curic Chloride 1/32 gr. Aloes			Ferri Arsen (et c. Strych.		
Extract, Nux Vomica Ex-			HCl., gr. 1/60)		176
tract, Belladonna Extract $\frac{1}{4}$			„ (<i>Blaud</i>), Carb. 5 to 15		
grain each. Used in salpin-			gr.		408 & 72
gitis.—Langford Moore,			„ Carb. Sacch., 4 gr.		408
P.J.i/20, 39			„ Glyceroph., 1 <i>c.cib.</i> . . .		
Chlorure Mercurique Opiacées .		464	„ Hypoph. c. Strych., 2		
Cocainæ HCl., 1/5 gr.		324	or 3 <i>p.d.</i>		639
Codeinæ Co., $\frac{1}{4}$ to 2 gr. . . .		340	„ Iodidi 3 to 8 gr.		416
(Mucilage as Excipient not Syrup.)					

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Pilulæ—			Pilulæ—		
Ferri Quin. et Strych. Phosph.			Hyd. Tannat., 1 to 4 gr. . .	472	
(et c. Arsen.) . .	418		Hydrastin, $\frac{3}{4}$ & 1 gr., 1 <i>p.d.</i> . .	472	
„ Sulph. Exs., 3, 5 gr. . .	419		Hyoscinae HBr., 1/400 to		
„ Redact, 1, 2 gr. . .	408		1/150 gr. . .	482	
Ferri Redacti, 1 gr., Ext.			Hyoscyaminæ, 1/200 gr. incr.	482	
Nux. Vom., $\frac{1}{4}$ or $\frac{1}{2}$ gr. . .			Ichthyol, Ammon., 2 $\frac{1}{2}$ gr.		
Ferri Sulph., 1 gr., c. Strych.,			Lith. & Soda (of either		
1/30 gr. . .			1 $\frac{1}{2}$ gr.), 4 to 12 daily . .	489	
Filicis Ext., 3 m. . .	421		Iodoformi, $\frac{1}{2}$ to 3 gr. . .		
Galbani Co. (B.P. '98), 4 to 8 gr.			<i>Ipec. c. Scilla</i> , 4 to 8 gr. . .		
Garrodii . .	416		<i>Ipecac. c. Uriginea</i> , 4 to 8 gr. . .	829	
Gossypii Co., 3 or 4 daily . .	441		<i>Ipecac.</i> (Salol ctd.) . .	510	
Glycerophosphatum, 4 gr. . .	42		Iridin 2 gr. 1 <i>h.s.</i> . .	802	
Gout—			Laxativæ Co... . .	133	
Pil. Hydrarg. gr., 1; Ext.			Lecithin, 1 $\frac{1}{2}$ gr. . .	525	
Colchici, gr., $\frac{1}{4}$; Pil.			„ c. Ferri. Iodid. . .	525	
Col. c. Hyos. gr. 1 $\frac{1}{2}$.			Lithii Guaiacatis, 5 gr. . .	528	
Gregory = Col. Co. . .	367		Magnes. Oleat, 5 gr... . .	587	
Guaiacol, 1 to 3 gr. . .	375		Male Fern Ext., 3 m. . .	421	
Guy's . .	389		Meglin. . .	486	
Hamilton . .	367		Mentholis . .	541	
Hutchinson, N.H.W. = Hyd.			Meth. Blue, $\frac{1}{2}$, 1, 2 gr. . .	311	
c. Cret., Pulv. Ipec. Co.,			Monckton . .	176	
<i>a.a.</i> gr. 1.			Morphinæ Mec., HCl., Sulph.,		
<i>Hydrargyri</i> , 4 to 8 gr. . .	451		$\frac{1}{4}$ gr. . .	546 et seq	
Hyd. et Digital. Co... . .	389		Naphthol-B, 3-5 gr. . .	552	
{ Pil. Hyd., 2 $\frac{1}{2}$ gr. }			Naphthalini, 3 gr. . .	552	
{ Pil. Coloc. Co., 2 $\frac{1}{2}$ gr. }			Neuralgic . .	242	
{ Pil. Hyd., 2 $\frac{1}{2}$ gr. }			Niemeyer . .	389	
{ Pil. Rhei Co., 2 $\frac{1}{2}$ gr. }			Ogilvie (Papain Co.), 1 <i>c. cib.</i>	622	
{ Pil. Hyd., 1 gr. }			Opii Pulv., $\frac{1}{2}$ and 1 gr. . .		
{ Pil. Col. c. Hyos., 4 gr. }		‘Third night.’	Pepsin, 2 and 3 gr... . .	630	
{ Pil. Hyd., 1 $\frac{1}{2}$ gr. }			{ Pepsin, gr. 1, Quin. Sulph.		
{ Ext. Col. Co., 2 gr. }			gr. 1, Strych. 1/30 gr., Ext.		
{ Ipecac., $\frac{1}{2}$ gr. }			Tarax.gr.2.—Sir W. Gowers.		
{ Ext. Hyos., 1 gr. }			Phosphori (Martindale), 1/100,		
{ Pil. Hyd., 3 gr. }			1/50 & 1/30 gr., 1 <i>p.c.</i>	630	
{ Opii Pulv., $\frac{1}{4}$ gr. }			„ c. Ferro et Nuc. Vom.	630	
Hyd. c. Creta, $\frac{1}{3}$, $\frac{1}{2}$ gr.			„ „ Ferro, Quin. et Strych.	630	
{ Hyd. c. Creta, 1, 2, $\frac{1}{3}$ gr. }			„ „ c. Nuc. Vomic. . .	630	
{ P. Ipec. Co., 1, 2, 3 gr. }			„ „ c. Quin. . .	630	
Hyd. Cyanidi 1/10 gr. . .	454		„ „ c. Strych. et c. Ferro	630	
Hyd. Iod. Flavi, $\frac{1}{8}$ gr. . .	459		Picis Liq., 2 gr., 1 or 2 . .	650	
Hyd. Iod. Rub., 1/50 to $\frac{1}{8}$ gr.	456		Picrotoxin, 1/100 to 1/30 gr. <i>h.s.</i>	81	
Hyd. Iod. Rub., $\frac{1}{8}$ gr., et Pot.			„ Atrop. et Agaricin . .	81	
Iod., 4 gr. . .	459		Pilocarpinæ Nit., 1/20 to $\frac{1}{2}$ gr.	52	
Hyd. Iod., Vir. $\frac{1}{8}$ to $\frac{1}{2}$ gr. . .	459		<i>Plumbi c. Opio</i> , 2-4 gr. (about		
Hyd. Iod. Vir., B.S.H.—Hyd			12 $\frac{1}{2}$ % Opium) . .		
Iod. $\frac{1}{2}$ gr., Opium $\frac{1}{4}$ gr.,			Plummer's, 4 to 8 gr. . .		
Ext. Gent., 2 gr.			Podoph. Bellad. et Capsic. . .	65	
Hyd. Perchlor., 1/40 to 1/12 gr.	464		Podophyllin, 1/30 to 1 gr. . .	65	
„ „ Co. see Pil. Champney			„ Co., 1 or 2 <i>h.s.</i> . .	65	
Hyd. Subchlor., $\frac{1}{2}$ to 3 gr. . .			„ et Quin. <i>c. cib.</i> . .	65	
<i>Hyd. Subchlor.</i> Co., 4 to 8 gr.			Poore . .	65	
{ Hyd. Subchlor., 2 gr. }			Potassii Bichrom., 1/10 gr... .	65	
{ Coloc. Pil., 2 gr. }			„ Iod., 1 gr., or more . .	66	
{ Pil. Rhei Co., 2 gr. }			„ Permang., 1 to 5 gr. . .	53	
(Army Pill-No. 9.)			Potentin Co. . .	81	
{ Hyd. Subchlor., 1, 2 gr. }			Quin. \acute{c} . Bellad. . .	22	
{ Pil. Col. c. Hyos., 3, 4 gr. }			Quin. Hydrargyri et Opii . .	67	
{ Hyd. Subchlor., 1, 2 gr. }			„ Ipecac. et Camphora . .	67	
{ Opii Pulv., $\frac{1}{4}$ gr., 1 gr. }			„ Salicyl, 2-6 gr... . .	67	
Hyd. Subchlor., Rhei, Cas-			„ Sulph., 1 to 5 gr. . .	67	
cara et Capsic. . .	471		„ Valer., 1 gr. . .	67	

FIGURES IN HEAVY TYPE, e.g. 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Pilulæ—			Piropiasmosis		186
<i>Rhei Co.</i> , 2½, 3, 4, and 5 gr. . .		684	Piscidia, 816; Pistoia Powders ..		816
{ <i>Pil. Rhei. Co.</i> , 4 gr.		t.d.	Pistachia Lentiscus		808
{ Ext. Nuc. Vom., ½ gr.			Pitch, Burgundy		651
{ <i>Pil. Rhei. Co.</i> , 2½ gr.		h.s.	Pitchblende 750 & Ra. Chptr., .		306
{ Ext. Tarax., 2½ gr.			Ointment		336
<i>Rufi = Pil. Aloes et Myrrh</i> ..			Pitfield's Stains		549
Salol, 2½ gr.		93	Pithing of Progs		68
Santonin, ½ gr.		688	Pitibulin		920
<i>Saponis Co.</i> , (20% Opium),			Pituglandol		920
2 to 4 gr.			Pituitary Gland	917,	151
Scammon. Co. (B.P. '98), 4-8 gr.			Dry <i>Entire</i> , 1 to 3 gr. t.d. . .		919
<i>Scillæ Co.</i> , 4 to 8 gr.		821	„ <i>Anterior Lobe</i> , 1 to 4 gr. .		919
Selenii Oxidi c. Eosin		731	„ <i>Posterior Lobe</i> , 1 to 4 gr. .		919
Sodii Arsenat., 1/32, 1/64 gr. .		179	Liquid Ext. <i>Entire</i> Gl. Special,		
„ Cacodyl., ½ gr.		182	½ to 1 Cc. intram.		919
„ Chaulmoograte 'A,' ..			Liq. Ext. <i>Infundib.</i> , ½ to 1 Cc.		
1, 2 & 3 gr.		591	intram.		919
„ Oleatis, 2 and 4 gr. . . .		689	Active Principles, Recogn. of		920
Sparteïn Sulph., ¼ gr.		715	Assay		920
Spender, N.H.W. — Ferri.			Phys. Examn. Author's		920
Sulph., 2 gr., Ext. Aloes			Contraindications to use of. .		921
1 gr., Ext. Bellad., ½ gr. . .			Uses and Refs.	921, 922	
Strophanthi Tinct. 2m. 1 to 3		722	In labour	921, 922	
Strych. 1/100 to 1/25 gr. . .		723	Galactagogue Action. . . .	921, 922	
Sulphatum		256	Pituitarin, Pituitrin		920
“Third { <i>Pil. Hyd.</i> , 1 gr. }			Pityriasis Versicolor		502
Night” { and Col. c. }			Pix Burgundica		651
{ Hyos., 4 gr. }			„ <i>Carbonis</i>		292
Thyroglandin, 1 gr.		935	„ <i>Liquida</i> , 2 to 10 gr. . .	651 &	136
Triplex, 1 to 3		132	Pituglandol		920
Trium Phosphatum		419	Placenta, Placentine	158,	375
Unna's Chaulmoograte		592	Plague		502
<i>Urgineæ Co.</i> , 4-8 gr.		829	„ Transmission		503
Valerian Co. = Trium			„ Bacteriology of		503
Valerianatum		679	„ Epidemiology		503
Zinci c. Bellad., 1 or 2		766	„ L.G.B. on		504
„ Phosph., ½ gr. 1 t.d. . .		638	Plantago Ovata		803
{ Valer., 1 gr.		761	Plasma, Horse, 895; Isotonic. .		702
{ <i>Pil. Asaf. Co.</i> , 2 gr.			Plasm. Malarix		498
Zn. Valer. Co., N.H.W. = Zn.			Plasmon Preps.		575
Valer., 1½ gr., Asaf., 2 gr.			Plaster Mulls	550,	49
Ext. Bellad., 1/12 gr. . . .			„ Paris 108, and Band-		
Pimento	815,	151	ages		255
Pine Apple, 779; Essence		23	Plasters, Rubber, White Ad:		
Pineal body		917	hesive, 551 v. also		265
Pinenes, 136; Pinheroin, 1 dr.,			Plates, Photo, Colour Sensitive		288
648; Pink Pills, 576; Pink			Platino cy. Screen		287
Root, Indian		824	Platinum and Chloride, 816,		
Pinol, 648; Pinta		502	174; Colloidal	349,	360
Pinus Canadensis, 815; Mari-			Pleurisy Root		782
tima 636; Pumilio, 648;			Plimmer's Bodies		472
Siberica, 648; Strobis, 815;			<i>Plumbi Acet.</i> , 1 to 5 gr. . .		653
Sylvestris	646,	136	„ Carb.		654
Piodyn		70	„ <i>Iodid.</i> , 654; Lact.		68
Piper Betle		784	„ Nitras		654
<i>Piper Long.</i> and Nig.		815	„ Oleatum	582,	584
Piper Methystic		804	„ <i>Oxidum</i>		654
Piperazin, 4 to 10 gr.; Tabs.,			<i>Plummer's Pill = Pil. Hyd. Sub. Co.</i>		
5 gr., 649; Benz.; Glyceroph.			Pluriglandular Ext.		936
Salicyl., 2 to 5 gr.		650	Pneumobacillus & Coccus, 868 et seq.		
Piperidine and Acid Tart, 15 gr.		650	& 506		
„ -p-Sulpham. Benz. . . .		651	Pneumonia and Vaccine		868
Piperin, 1 to 10 gr.		815	„ Dose 50 m. to 2000 mill. .		868
Piperonal		800	„ Rockefeller Inst. Work. .		869

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Pneumonia Serum, 20 to 30 Cc.		871	Potass Binoxalas	74
" " Pane	.. ..	871	" Bisulph.	.. ..	668
Pneumothorax, Artificial	.. ..	616	" Bitart, 20 to 60 or 240 gr.	668	
<i>Podophylli Res. & Indica.</i> , $\frac{1}{4}$ -1 gr.	655,	138	" Boro-tart., 20 to 40 gr.	664	
<i>Podophylli Rhiz.</i>	.. ..	655, 138	" Bromid., 5-30 gr.	657 & 43, 138	
Podophyllin, $\frac{1}{4}$ to 1 gr.	.. ..	655	" Cantharidas, 1-400 to		
Podophyllotoxin, 1/10 to $\frac{1}{8}$ gr.	655		1-200 gr. hypod.	.. ..	263
Points, Alum and Copper Sulph.	134		" Carb., 5 to 20 gr.	.. ..	658
Poison Bush, 773; Oak, or Ivy	819		" Chloras, 5-15 gr.	658 & 139	
Poisons, Antidotes to..	1021		" Chlorid.	.. ..	659
And see Drug in question.			" Chloroplatinite..	.. ..	810
Gases..	1022, 457 et seq		" Chromate	.. ..	171
" Horticultural, (<i>e.g.</i> ,			" Citras, 15-60 gr.	.. ..	659
Acid, Arsenios, Ac.			" Eff., 1 dr.	.. ..
Carbolic, Ac. Hydro-			" Cyanidum (1/12- $\frac{1}{4}$ gr.)	659 &	139
cyanic, Cupri Aceto					
Arsenis, Nicotine,			" Dihydric-phosph.	.. ..	663
MercuricChloride)	172, 943		" Ferrocyanidum, 8 gr.	.660 &	171
" (Ireland) Act..	.. ..	948			
" and Pharmacy Act and			" Formas, 1-6 to 3 gr.	.. ..	39
Schedule (1908)	943, 945		" Glyceroph. 3-8 gr.	.. ..	4
" Schedule, 1921 Re-			" Guaiac-sulphonate, 15 gr.	37	
visions, Vol. II., p. XXXI			" <i>Hydroxidum</i>	.. ..	659
" Through the post	.. ..	947	" Hypophos., 1 to 6 gr.	.. ..	639
" in Water, Detection..	419		" Iodidum, 5-20 gr.	.. ..	660
" Wholesale Trading	.. ..	947	" Margosate	.. ..	78
'Poisonous' Substances, 13, 32 47,			" Metabisulphis	.. ..	139
73, 74, 97, 141, 946			" Myronas	.. ..	14
Poke Root	.. ..	814	" Nitras, 5 to 20 gr.	.. ..	66
Polenske No.	.. ..	456	" Nitris, $\frac{1}{4}$ to 1 $\frac{1}{2}$ gr.	.. ..	66
Pollard's Stain	.. ..	549	" Osmas, 773; Oleas,	582, 68	
Pollen Vaccine	.. ..	862 <i>et seq.</i>	" Oxalas Acid	.. ..	7
Polonium	.. ..	315	" Percarbonas	.. ..	139
Polyaminoarsenobenzenes	.. ..	209	" <i>Permang.</i> , 1 to 3 gr.	536 139	
Polygala..	.. ..	822	" Permang Spray for C Sp.		
Polygonum var.	.. ..	816	Fever	.. ..	85
Polyneuritis	.. ..	105, 468	" Persulph.	.. ..	14
Polyomyelitis	.. ..	506	" Phosphas, 1 to 10 gr.	.. ..	66
Polyporus Officinalis	.. ..	776	" Picras	.. ..	7
Polyvalent Sera	.. ..	836	" Salicylas, 5 to 30 gr.	.. ..	8
Pomatum Antipsoricum	.. ..	731	" Silicas	.. ..	71
Pomade Max	.. ..	263	" Succinas, 5 to 10 gr.	.. ..	9
Pomegranate Bark	.. ..	630	" Sulphas., 15 to 45 gr.	.. ..	66
Pommade aux Concomb	.. ..	792	" Acid	.. ..	66
" de Lyon	.. ..	473	" Sulphocarb., 10 gr.	.. ..	66
" Reclus.	.. ..	315	" Sulphocyanid., $\frac{3}{4}$ to 3 gr.	.. ..	66
Pond's Extract, 443; Tampons	437		Bact. Medium	.. ..	48
Ponos	.. ..	492	" Tart., $\frac{1}{2}$ to 4 dr.	.. ..	66
Poore's Pill	.. ..	655	" " Acidus, 15 to 60 gr.	663, 139	
Poppy Capsules	.. ..	604	" Telluras..	.. ..	48
Poppy Seed Oil..	.. ..	597	" et Sodii Tart., 120-240 gr.	71	
Populus, Populin, 1 to 4 gr.	.. ..	816	" Tetroxalas	.. ..	7
Portable Inhaler	.. ..	539	Potassio-Cupric Tart. Sol.	.. ..	39
Portland Cement	.. ..	137	" Mercuric Iodide	.. ..	45
Poslam	.. ..	576	Potassium	.. ..	65
Potassa Caustica	.. ..	656	Potion Gommeuse	.. ..	77
" <i>Sulphurata</i> , 2-8 gr.	.. ..	656	Potato, Bacteriological	.. ..	56
Potassic Aperient (et c. Pot.			Starch in Bread	.. ..	10
Sulphoc.), 1 dr.	.. ..	662	" Sweet	.. ..	80
Potass. <i>Acetas</i> , 10-60 gr.	.. ..	656	Potentin Pilula, Co., 3-6 p.d...	81	
" Arsenis, 1/32 to 1/16 gr.	178		Potion Iodurée, 3 oz. in dil.	.. ..	66
" Benzoas, 15-20 gr.	657	Potter's Walnut Juice Hair Dye	30	
" <i>Bicarb.</i> , 5-20 gr.	657	Potus Imperialis	66
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Secretogen Elixir, 1 to 2 dr. and Tabs.		914	„ Præparatum		637
Section cutting and staining		553	Sewage		428
Secwa		574	Sheep Dips		172
“Sedeff,” 1 to 2 dr. in aq. ..		226	Sheep's Corpuscles, 518 ; Serum, 895; Wool		437
Sedobrol Tabs., 1 to 3 <i>p.d.</i> ..		240	Shellac		823
<i>Seidlitz Powder</i>		713	Shipway Apparatus		280
Seigel's Syrup		577	Side Chain Theory		833
Seignette Salt, 120-240gr. ..		713	Sidonal, New, 30 gr.		650
Sel Anglais		531	Silcock's Ointment		456
Sel de Barnit 100; de Javelle ..		50	Silica 710; Silicon Carbide ..		290
Seleniol		365	Silicates, Soda and Potash 709,		710
Selenium		731	Silk, Artificial, 440; Sutures ..		527
„ Colloidal 309, 360, 364			Silkworm Gut		527
„ Comps., Organic 731, 151			Silphion		828
„ Oxide		731	Silver Gelatose		171
„ with Eosin		731	„ German		811
Self Inflator Drops		285	„ Hair Dye		29
Self's Vanadate Test		10	„ Nitrate, $\frac{1}{4}$ to $\frac{1}{2}$ gr. ..		167
Seliwanoff's Reaction		405	„ „ <i>Mitigated</i>		169
Semen Erucae Sinapis		694	„ „ <i>Toughened</i>		169
Semen Exam.		557	„ Oxide, $\frac{1}{2}$ to 2 gr. ..		169
Semolina		100	„ Salvarsan		142
Sempervirine		75	Simaruba	514, 823,	151
Sempervivum		822	Simpson Light		304
Semple, Sir D., and Typhoid ..		902	Simulium		501
Semprolin Emulsion		627	Simulo		823
Sempules, 732; Senecio. <i>var.</i> 822,		151	Sinalbin, Sinigrin, Sinapis	694,	144
<i>Senecæ Radix</i>		822	Sinclair's Gluc		802
<i>Senna</i> (and <i>Pods</i>), 10 to			Singleton's Ointment		577
30gr.		692 & 144	Sinusoidal Current		233
Sennatin		693	Sirolin, 1 to 4 dr.		378
Sensitised Vaccines		838	Sirop des cinq Racines		164
Septicæmia Serum		874	Sirop d'Erysimum, $\frac{1}{2}$ oz.		796
Septovince		23	(See also Syrupus).		
Sera, Theoretical on		832	Skin Sterilisation		466
Seroden Caps.		507	Skull Cap = Scutellaria		822
Serpent Venom		913, 509	Sleeping Sickness, 530 , and <i>v.</i> Therap. Ind.; Animals in Relation to, 534 et seq.		
<i>Serpentaria Rhizoma</i>		823	Slippery Elm Bark		829
Serum Agglutination		425, 546	Smallpox	904,	940
„ Albumin		367	Smedley's Paste		268
„ Anti-colon B.		855	Smelling Salts, Carbol		18
„ Antidiphthericum Purif. ..		857	Smilax Sarsaparilla		691
„ Antilytic		895	Smoking, Anti-Gum		918
„ Antimeningo		853	Snake Bite	913, 1006,	509
„ Diphtheria, 1,500 units (Proph. 500 to 1 000) ..		856	„ „ Lancets		537
„ „ „Conc.		857	„ „ Legros Outfit		537
„ Dysentery		858	„ „ root, 791; Black		790
„ Factitium, P. Belg.		698	„ „ Venom	913,	509
„ Flexner's		853	Soamin, $\frac{1}{2}$ to 3 gr. increased ..		183
„ Globulin		367	Soap Bark		818
„ Hæmostatic		896	„ Liniment		690
„ Horse		895	„ Solution, 418 ; Ethereal ..		690
„ Mineral Waters as		702	„ „ and Spirit Lotion		690
„ Nevrosthénique		46	Soaps, Household, Shaving, Medicated, etc., 690 <i>et seq.</i> & 142 et seq.		
„ Normal Horse		895	Soda Caustic		707
„ Proteins		367	„ Chlorinat. Liq.		50
(SEE ALSO SPECIFIC DISEASES OR ORGANISMS AND VACCINES).			„ „ Crystal 'Conc.		705
<i>Sesame Oil</i>		603	„ Tartarata, 2 to 4 dr. ..		713
Sesquiterpenes		112			

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Sodii Acetas, 15 gr. . . .		696	Sodii Indigo Sulphonas . . .		53
„ Acetocoumaras, 5 gr. . .		31	„ Lactas, 5 to 10 gr. . .		68
„ Amino-Phenol arsonas, $\frac{3}{4}$ to 3 gr. . . .		183 & 31	„ Mag. Sulph. Eff., 60 gr. or <i>q.s.</i> . . .		711
„ Arsanilas, . . .		183 & 31	„ „ „ c. Caffein . . .		711
„ Biboras, 5 to 20 gr. . .		12 & 2	„ Margosate . . .		782
„ Bicarbonas, 5-30 gr. . .		703	„ Metabisulphis, 2 to 5 gr. . .		713
„ „ Sterilisation . . .		266	„ Methylarsonas, $\frac{2}{5}$ to 3 gr. . . .		183
„ Bisulphas, . . .		710	„ Monoboras, . . .		13
„ „ Tabs. for baths . . .		711	„ Morrhuas Solution (3%), $\frac{1}{2}$ to 4 Cc. (Injected) . .		595
„ Bisulphis, 5 to 30 grains . .		713	„ Nitras, 5 to 15 gr. . .		707
„ Bi-uras . . .		416	„ Nitris, 1 to 2 gr. . .		707
„ Boras . . .		12	„ Nitrophenyl-propiolas . .		404
„ Boro-Salicyl, 5 to 45 gr. . .		10	„ Nitroprussidum . . .		362
„ „ Tart., 30 gr. . .		12	„ Nucleinas, <i>per os.</i> , $\frac{1}{2}$ to 2 gr. . . .		274
„ Bromid., 5-30 gr. . .		703, 43	„ Oleas, 2 to 4 gr. . .		689
„ Cacodylas, $\frac{1}{2}$ to 1 gr. . .		181	„ o-coumaras, 5 gr. in sol. . .		29
„ Caffein-Iodid., 2-10 gr. . .		247	„ o-cresotinas, 10 to 30 gr. . .		95
„ Carbolas . . .		18	„ o-nitrophenylpropiol . . .		404
„ Carb. (<i>Exsicc.</i> , 3 to 10 gr, 705); 5 to 30 gr. . .		704	„ Palmitas . . .		142
„ „ Monohydrat . . .		705	„ Perboras, 12; T. Powder . .		13, 2
„ Chaulmoograte, Pure Commercial . . .		589	„ Permang. . . .		538
„ „ ‘A’ 1 to 3 gr. <i>per os.</i> . .		590	„ Peroxidum . . .		480, 611
„ „ ‘C’ 1 to 3 gr. <i>hypod.</i> . .		590	„ Persulph., 1 to 3 gr. . .		710, 145
„ Chloras, 10 to 30 gr. . .		705	„ Phenol-p-sulphonas, 5 to 15 gr. . . .		20
„ Chloridum, 10-60 gr. . .		696	„ Phenol-sulphoricinas . . .		599
„ Ciunamas, 3 to 5 gr. . .		28	„ Phenylpropiolas . . .		29, 404
„ Citras, 10 to 60 gr. . .		705	„ Phosphas., $\frac{1}{4}$ to $\frac{1}{2}$ oz.; 30-120 gr. rep. . . .		708
„ Citro-Tart. Eff., 1-2 dr. . .			„ Phosphas Acidus, 30 to 60 gr. . . .		709
„ Coumaras Sol., 25 m. . .		30	„ „ Eff., 1 to 3 dr. . .		708
„ „ c. Novocain, 25 m. . .		30	„ „ Exsicc., 10 gr. to 4 dr. . .		709
„ „ et Adrenalin, 35 m. . .		30	„ „ Neutral (Tribasic) . .		708
„ Cresotinas, 10-30 grs. . .		95	„ Phosphis . . .		708
„ Desoxycholas . . .		715	„ Potass. Tart., 2-4 dr. . .		713
„ Dimethylarsanilas . . .		31	„ Pyrosulphis, 2-5 gr. . .		713
„ Dimethylarsinas, $\frac{1}{2}$ to 1 gr. .		181	„ Rhodanidum . . .		713
„ Dioxidum . . .		480	„ Salicylas, 10 to 30 gr. . .		83, 151, 360
„ Dioxydiamido-arseno-benzene-mono-methane Sulphonate . . .		205	„ Sesquicarb. . . .		705
„ et Ammon. Phosph. . .		709	„ Sesquiphosphas, 30 gr. during a day . . .		709
„ et Mag. Sulph. Eff., 1 dr. or more . . .		711	„ Silicas, 709; Stearas 689 & . .		142
„ et Mag. Sulph. c. Caffeina 1 dr. or more . . .		711	„ Succinas, 2 to 5 gr. . .		96
„ et Potass. Tart. 120 to 240 gr. . . .		713	„ Sulphanilas, 5-15 gr. . .		301
„ Ethylas . . .		707	„ Sulph., $\frac{1}{4}$ to $\frac{1}{2}$ oz. or 30 to 120 gr. rep. . . .		711
„ Fluorid, 1-20 to $\frac{1}{2}$ gr. . .		773	„ „ Eff., 60 gr. or <i>q.s.</i> . .		711
„ Formas, 1-6 to 3 gr. incr: . .		38	„ „ Exsicc., $\frac{1}{2}$ to 2 dr. . .		711
„ Glyceroph., 5-10 gr. . .		43	„ „ Acidus . . .		710 & 360
„ Glyco-cholas, 2-6 gr. . .		714 & 519	„ Sulphidum . . .		713
„ Hippuras, 5 to 30 gr. . .		7	„ Sulphis, 5 to 20 gr. . .		712 & 360
„ Hydroxid. . . .		703	„ „ Exsicc . . .		713
„ Hypobrom, Sol. . . .		410	„ Sulphocarb., 5 to 15 gr. . .		20
„ Hypochloris . . .		59	„ Sulphocyanid., 1 to 5 gr. . .		713
„ Hypophosph., 3-10 gr. . .		635	„ Sulpho-Ichthyolas, 10 to 30 gr. . . .		488
„ Hyposulph., 10-60 gr. . .		98 & 146	„ Sulphoricinas . . .		599
„ Iodas, $1\frac{1}{2}$ gr. Hyp. . .		67	„ Tart. Neutrale, $\frac{1}{2}$ to 1 oz. . .		713
„ Iodidum, 5 to 20 gr. . .		707			

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NAME.	DOSE.	PAGE.	NAME.	DOSE.	PAGE.
Sodii Tauro-chloas, 2 to 6 gr.		714 & 423	Soluté Officinale d'Eau Oxygénée		477
" Tetra-iodofluorescein ..		386	Solutio Burowi		134
" Thiocyanas		713	" Creosoti Co.		374
" Thiosulph., 10 to 60 gr. ..		98	" Phenolis		16
" Triphenyl-rosaniline mono-sulphonas		1	" Vanillin		829
" Tungstas Sol. X Rays ..		239	Solut. d'Ergotinine, 3 to 10 m.		39
" Uras Acidus		416	" Aluminii Acet.		134
" Valerianas, 1-5 gr. ..		761	Solutio de Cacodyli Iodo-mercurico		185
" Vanadas, $\frac{1}{2}$ gr. ..		829	Solvent Naphtha		304
Sodium	696 &	145	Somatose		566
" Chloride Shells		698	Somnacetin		759
" Fluorescein		635	Somnoform (Caps.)		114
" Salvarsan.		205	Sonnenschein's Test		174
" Tylmarin, 5 gr. ..		31	Sorbefacin		430
" Veronal, 5 to 10 gr. ..		756	Sorbus, 824; Sorensen's Test, 123, 392; Sorghum, ..		824
Solanum, 823 & 824; Sodomæum, 823; Soil Bacteria, 557; Solanine, $\frac{1}{2}$ to $\frac{1}{2}$ gr.		823	Soudan Red III.		311
Solazzi, 433; Soldiers and Narcotic Drugs, 953; Solubes ..		465	Soya 568, 597, 822, 369, 414, 415		496
Sols, Colloidal	346 et seq		Soziodol (and Comps.) ..		261
" Iodine		357	Spanish or Blistering Fly ..		546
SOLUBES (see also Solubes Ionic)			Spahlinger's Serum		828
" Biniodide, 1 in 1 pint = 1 in 1,000		459, 80	Sparadrap de Thapsia ..		124
" Boric Acid, 15 gr. ..		11	Spasmodin, 2 to 6 m. (in solution)		303
" Borax Cocaine Co. ..		11	Sparteine HCl. and Sulphas, $\frac{1}{2}$ to 1 gr.		715
" Borax Co.		11	Spearmint!		809
" Boro-Saline		11	Spermatozoa		557
" Cocaine, 1, 1, 2 $\frac{1}{4}$, 5 gr. ..		324	Species Pectorales		434
" Dental		18	Specificity in Antiseptics ..		348
" Eucaine, 1 & 5 gr. ..		330	Spermaceti, 789; Spermin ..		932
" " 0.05 c. Sod. Chlorid. 0.2 Gm.		330	Sphacelotoxin, 1/100 gr. ..		398
" Hyd. Cyanid. et Boracis ..		454	Sphagnol and Preps. ..		490
" Hyd. Oxyey, 0.2 Gm. ..		455	Sphagnum (see also Moss) ..		716
" Perchloride		465	Sphygmograph. Varnish ..		6
" 1 in tumb. = 1 in 4,500 1 in pint. = 1 in 1,000 1 in pint. = 1 in 500			Sphygmomanometers		388
" Phenol, 5 & 20 gr. ..		15	Spiegler's Test		373
" Plumbi et Opii		654	Spigelia Marilandica		824
" Potass. Permang., 5 gr. ..		538	Spinal Anæsthesia. See Anæsthesia & Drugs in question.		
" Sodii Chlorid.		698	Spinal Cord Ext. (5-20 m.) ..		913
" " Comp.		701	" " Tabs., 2 $\frac{1}{2}$ gr. ..		913
" Zinci Permang., $\frac{1}{4}$ gr. ..		538	Spinthariscopes		314
" Zinc Sulph. et c. Alum ..		768	Spirillum Cholerae, 854; see also Spirochaeta.		
" Zn. Sulphocarb., 2 & 10 gr.		20	Spirit Blue, 1; Weed		805
SOLUBES, IONIC, Cocaine, Copper, Lithium, Mag. Sulph. Mercury, Pot. Iod. Quin. Hcl. Ac., Sod. Chlor., Zinc Sulph.		286	" of Tar		651
Soluble Glass	709, 710		Spirit. Acidi Lactici		67
Solurol, 5 to 10 gr. ..		933	" Aetheris, 60 to 90 m., 20 to 40 m. rep. ..		111
Soluté Digitaline Crist., max. single, 5 m.		390	" Camph.		369
" de Quinine hypoderm. ..		670	" Co., 60 to 90 m., 20 to 40 m. rep. ..		111
" de Valerianate d'Ammoniaque Comp., 2 to 4 dr.		140	" Nitrosi, 15 to 60 m. ..		111
" Morphine (HCl.), 2% ..		545	" Ammon., U.S. viii, 15 m.		143
" Bromoform, max., 8 m. ..		240	" " Aromat., 60 to 90 m., 20 to 40 m. rep. 143 & 24		
			" Fetidus, 60 to 90 m., 20 to 40 m. rep. ..		143
			" Amygd. Amar., av. 8 m.		145
			" Anisi, 5 to 20 m. ..		780

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Spirit Antiparalyticus	647	Spray Solutions 554; Sprue	510
„ <i>Armoraciac Co.</i> , 1 to 2 dr.	..	791	Spruee, Hemlock ..	..	815
„ <i>Aurantii Co.</i> , U.S.	392	Stainless Iodine Ointment ..	..	506
„ <i>Cajuputi</i> , 10%, 5 to 20 m.	..	258	Stains, to remove ..	..	582, 583
„ <i>Camphoræ</i> , 5 to 20 m...	..	258	Standard Bread ..	..	100
„ „ <i>Fort.</i> , 2 to 5 m.	259	Standard Cultures and Agglu-	..	..
„ <i>Capillaris</i>	682	tinating Sera ..	..	547
„ <i>Card. Co.</i>	619	Standardisation Physiol. <i>see</i> Tinet.	..	..
„ <i>Chloroformi</i> , 5 to 40 m.	..	286	„ <i>Digitalis</i> and ..	..	159
„ <i>Cinnamomi</i> , 5 to 20 m.	..	291	Stannum ..	..	824
„ <i>Coloniensis</i>	120	Stanni Oleas ..	..	586
„ <i>Creosoti</i> , 1 dr.	372	Stannoxyd Tablets ..	..	824
„ <i>Denaturalised</i>	121	Stavesacre ..	..	825
„ <i>Dilution Tables</i> 116, 117	Staphisagriæ Oleum & Ung. ..	..	825
„ and 18 <i>et seq.</i>	„ <i>Sem.</i> , 1 gr. ..	..	825
„ <i>Duty and Rebate</i>	116	Staphylo. Alb., aur. 510 , Vae-	..	..
„ <i>Dzondii</i>	143	eine ..	..	875
„ <i>Frumenti</i>	120	Star Grass, 776; Starch, 779,	..	..
„ <i>Glycerin</i>	119	172 (Indicator); Powders ..	..	766
„ <i>Glyceryl Nit.</i> , av. 1 m.	..	558	Starchless Bread ..	..	576
„ <i>Grindeliæ Co.</i> , 1 to 2 dr.	..	442	Steapsin, 617, 70 ; Stearin ..	..	95
„ <i>Hyd. Biniodidi</i>	456	Stearettes ..	..	644, 734
„ <i>Juniperi</i> , 5 to 20 m.	803	„ <i>Caleii Sulphidi</i> , 1 gr. ..	..	256
„ „ <i>Co.</i> U.S., av. 2 dr.	..	803	„ <i>Emetine</i> , $\frac{1}{4}$ $\frac{3}{4}$ gr. ..	..	516
„ <i>Lavandulæ</i> (10% of Oil),	„ <i>Emetine Bism. Iodid.</i>,	..	..
5 to 20 m.	1, 2 & 3 gr. ..	..	519
„ <i>Melissæ Co.</i> , 20-25 drops	..	808	„ <i>Fel Bovini</i> , 5 gr... ..	..	407
„ <i>Mentha Pip.</i> , 5 to 20 m.	..	808	„ <i>Magnesium Peroxid.</i> , 3 gr.	..	480
„ <i>Methylatus</i> , 121; Indus-	„ <i>Sulphur</i> , 5 gr. ..	..	729
trial 121; 'Power'	122	„ <i>Other Comps.</i> ..	..	644
„ <i>Myrciæ</i>	120	Stearoptene, Otto ..	..	122
„ <i>Myristicæ</i> , 5 to 20 m.	810	Stedman's Powders ..	..	577
„ <i>Nue. Jugl.</i> , 1 to 4 dr.	804	Steedman's „ ..	..	577
„ <i>Proof</i>	115 & 19	Stegomyia ..	..	495, 555
„ <i>Rectificatus</i>	115, 20	Sterilisation of the Skin	..	466, 503
„ <i>Saponatus, var.</i>	690	Sterilla ..	..	691
„ <i>Sinapis, P. G. V.</i>	694	Sterilisation, Chapter ..	..	262
„ <i>Tenuior</i>	115 <i>et seq.</i> , 19	Sterilised Milk 571 <i>et seq.</i>;	..	..
„ <i>Thymol</i> , 3 to 15 m.	746	Olive Oil, Paraffin, etc. ..	..	145
„ <i>Vanillin Co.</i> , $\frac{1}{2}$ to 1 dr.	829	Sterilisers ..	..	571, 573
„ <i>Vini Reet. & Dilutus</i> 115, 19	„ <i>Tubes for testing effi-</i>	..	..
„ <i>Vini Galliei</i>	119, 22	ciency of ..	..	1
Spirochæta Dentium	1009, 513	“Steriloid” Dressings, 438; Jacket 699	..	..
„ <i>Duttoni</i>	529	Sterilised Dressings, Medicated	..	439
„ <i>Eurygyrata</i>	486	Sternberg's Mixture, 1 oz. ..	..	469
„ <i>Fœtida</i> , <i>see</i> Throat
„ <i>Uleeration.</i>
„ <i>ieterohæmorrhagiæ</i>	554		..	..
„ <i>Obermeieri</i>	507		..	..
„ <i>Pallida</i>	510		..	..
„ <i>Recurrentis</i>	507		..	..
„ <i>Refringens</i>	1009, 513		..	..
„ <i>Vineent's</i>	1009, 1013		..	..
Spiroone Inhalant	661		..	..
Spiroonema Pallidum	510		..	..
Spleen Desicc., 5 to 10 gr.	..	923		..	..
Splenomegaly, Tropical	492		..	..
Spodumene	317		..	..
Sponge Eduction	438		..	..
Sponges, Surgical	438		..	..
to Sterilise	145		..	..
Spongio Piline	437, 438		..	..
Sporotrichosis	509		..	..
Spot Wing, <i>A. Maculipennis</i>	..	495		..	..
Spotted Fever	849, 509		..	..

STERULES, HYPODERMIC

718, each containing:—

Aeonitine Nit., 1/600 gr. ..	104
Adrenalin Sol., 10 to 15 m... ..	930
Adrenalin Solution, 1/1000 gr.	..
with Cocaine, $\frac{1}{2}$ gr. ..	929 930
Adrovaine (Adrenalin, 1/200 ..	..
Stovaine, $\frac{1}{2}$ gr.) ..	930
Adreucaine, $\frac{1}{2}$ Cc. ..	330
Æther, $\frac{1}{2}$ dr. ..	107
Aq. Dest., 1 dr. ..	217
Amyl Nitrite, 15 m., hyp.	..
dose, 1 to 5 m. ..	150
See also Sterules, Inhalation.	..
Antimon. Cinnam. Inj., 15,	..
30 m. ..	155
„ Ox. Inj., 15, 30 m. ..	151
„ Sod. Tart., $\frac{1}{2}$ to 2 gr. ..	159

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STERULES, HYPODERMIC—<i>contd.</i>			STERULES, HYPODERMIC—<i>contd.</i>		
Antipyrin, 4 gr.		314	Hyd. & Potass. Hyposulphit.,		
„ et c. Cocaine, 1/20 gr. . .		315	$\frac{1}{8}$ gr.		468
Apomorph. HCl., 1/10 gr. . .		165	„ Salicyl-Arsenas, 1 gr. in		
Arrhenal, $\frac{1}{8}$ and $\frac{3}{4}$ gr. . . .		183	30 m.		179
Arsamin, $\frac{1}{8}$ and $\frac{3}{4}$ gr. in 15 m.		184	„ Subchlor., $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$		
Arsenic and Iron = $\frac{1}{2}$ and 1			and 1 gr.		471
mgr. As ₂ O ₃ in 15 m. . . .		179	„ Succinimid., $\frac{1}{8}$ gr. c.		
„ and Strychnine = 10 m. .		179	Cocaina Nit., $\frac{1}{8}$ gr. . .		472
„ Strychnine & Quinine			Hydrastinine HCl., $\frac{1}{4}$ gr. . .		476
10 m.		179	Hyoscine HBr., 1/100 gr.,		
Arsenii Iodidi, 1/100 gr. . .		177	482; et c. Morph., $\frac{1}{8}$, etc.		484
Atrop. Sulph., 1/100 gr. . .		214	Hysocine Comp.		484
„ and Strych.		484	inj. Hydrarg. Intramusc., 10m.		448
Becker's Solution (half			iodine (local)		503
strength), 3 Cc.		51	Iodinol, 30 & 60 m. . . .		499
Benzamine, $\frac{1}{4}$ and $\frac{1}{2}$ gr. . .		330	Iodoform c. Menthol . . .		493
Brandy, 1 dr.		120	Iron and Arsenic—		
Cacodylatum Co., 15 m. . .		182	No. 1 = $\frac{1}{2}$ mgr. As ₂ O ₃ . .		179
Caffeine Sod. Benz., 1 to 4 gr.		246	No. 2 = 1 mgr.		179
Caffeine Sod. Salicyl., 1,			Iron Citrate. $\frac{1}{2}$ and 1 gr. . .		409
2 gr.		246	„ „ 2 grs. c. Urea Quin.		409
Calcii Format., $\frac{3}{4}$ gr.		39	„ Glyceroph., $\frac{1}{2}$ gr. . . .		42
Calc. Glyceroph., 1 gr. . . .		41	Lecithin, $\frac{3}{4}$ gr.		525
Calomel, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 gr.		471	„ c. Guaiacol, $\frac{3}{4}$ gr. . . .		525
Camphor (in oil), $1\frac{1}{2}$ and 3 gr.		258	„ c. Strych., 1/120 gr. . .		525
„ $\frac{1}{2}$ gr. in Ether, 15 m. . .		258	Menthol, 1/5 gr.		540
Camphor, 3 gr. & Guaiacol, 2gr.		258	Mercurial Injn., 10 m. . .		448
Cicatricine, 15 m.		695	Methylene Blue		53
Cocaine HCl., 1/10, $\frac{1}{4}$ and $\frac{1}{2}$ gr.		325	Morph. Sulph., $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ & $\frac{1}{2}$ gr.		546
„ $\frac{1}{8}$ & Adrenalin, 1/1000			Morph., $\frac{1}{8}$ gr. c. Atropine		
gr. (Concephrin)		325	Sulph., 1/120 gr., and other		
Codeine Phosph., 1 gr. in 6 m.		340	strengths		546
Colloidal Metals, see "Sterules"			Normal Saline (conc. 360) . .		698
of Metals in question.			Novocaine, $\frac{1}{8}$ gr.		334
Copper Colloidal, 4 Cc. (1 in			„ $\frac{1}{8}$ gr. c. Adrenalin,		
2000)		355	1/1000 gr.		334
Cresote (in oil), $\frac{3}{4}$ gr. . . .			Nuclcinic Acid, $\frac{3}{4}$ gr. . . .		274
Curschmann's Soln., 1 Cc. . .		258	Peptone (and intravenous) . .		632
Diamorphine, HCl., 1/12 gr.		548	Phenolsulphonaphthalein . .		54
Digitalin, Pulv., 1/10 gr. . .		391	Pilocarpine Nitrate, 1/10, $\frac{1}{4}$, $\frac{1}{2}$ gr.		522
„ 1/10 gr. c. Strych. HCl.,			Pituitary Ext. (Infundib.),		
1/100 gr.		391	$\frac{1}{2}$ and 1 Cc.		919
Dionin, $\frac{1}{8}$ gr.		548	Pituitary Extract, $\frac{1}{2}$ and 1 Cc.		
Emetine HBr. & HCl., $\frac{1}{4}$ to $\frac{1}{2}$ gr.		516	<i>Entire Gland Special</i> . . .		919
Enesol, 2 Cc.		179	Platinum Coll., 5 Cc. (1 in 4000)		360
Ergot Inj., 10 m.		397	Potass. Iod., 5 gr.		661
Ergotinine Cit., 1/100, 1/200 gr.		398	Quin. Formas, $\frac{1}{8}$, $\frac{3}{4}$ grain . .		666
Eucaïn, HCl. & Lact., $\frac{1}{4}$, $\frac{1}{2}$			„ Glyceroph., $\frac{1}{2}$ gr. . . .		43
and 1 gr.		330, 331	„ HBr. Acid, 2 gr.		666
Eucalyptus Oil, 5 m. c. Ol.		405	„ HCl. Acid, 2 gr., 3 gr.,		
Ferri Am. Cit., $\frac{1}{2}$ and 1 gr.,			5 gr. and 15 gr.		670
and with Quin. Urea . . .		409	„ „ 5 gr. c. Anti-		
Ferri Glyceroph., $\frac{1}{2}$ gr. . . .		42	pyrin, 3 gr.		670
Fibrocoumarin, 25 m.		30	„ Hydrochlorocarbamid.,		
„ 25 m. c. Adrenalin, 10 m.		30	3 and 5 Cc.		671
Glucose (Intrav.)		425	„ Urea (& c. Eucaïne), 3		
Gold Coll., 5 Cc. (1 in 4000)		357	and 5 Cc.		671
Guaiacol (in oil), $\frac{3}{4}$ gr. . . .		375	Saline Conc.		360
„ Cacodyl., $\frac{1}{2}$ to 2 gr. . . .		181	Scopolamine-Morph., 1/100		
Hydrarg. Coll., 5 Cc. (1 in			and $\frac{1}{8}$ gr., and with Atrop.		484
2000), (and c. Sulph.) . .		359	Selenium Coll., 1 to 5 Cc. (1		
Hyd. Glycocol., $\frac{1}{8}$ gr. . . .		4	in 5000)		360
„ Iod. Rub., 1/12 gr. in 8m.		457	Silver Coll., 5 Cc. (1 in 2000)		361
„ Peptonat, $\frac{1}{8}$ gr.		461			

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NAME.	DOSE.	PAGE
Sterules, Hypodermic—contd.		
Sod. Arsenatis et Strych., 10 m.	179	
„ „ „ et Quin., 10 m.	179	
„ Chloride	698	
„ Cacodyl, $\frac{3}{4}$ gr. . .	182	
„ „ Sod. Chaulmoog		
„ „ „ C, 1, 2 and 3 gr...	591	
„ Cinnam. (Glyc., 30 m.).	28	
„ Formate, $\frac{1}{8}$, $\frac{1}{2}$ gr. . .	39	
„ Glyceroph., 3 gr. . .	43	
„ „ 1 $\frac{1}{2}$ c. Strych. Cacodyl.,		
„ „ 1/64 1/20 gr. . .	43	
„ Nitritis, $\frac{1}{8}$, $\frac{3}{8}$, $\frac{1}{4}$ gr. . .	708	
„ o-Coumarin Sol., 25 m.	30	
„ „ c. Kerocain, 1/5 gr.	30	
„ „ et Adrenalin, 10m.	30	
Stovaine, $\frac{1}{8}$, $\frac{1}{2}$, $\frac{3}{4}$ gr...	336	
„ c. Dextrin Sol., 1.5 and		
„ 2 Cc. (Intraspinal) ..	337	
„ Glucose Sol., 1 Cc. . .	336	
„ Strychnine, 1 Cc. . .	338	
Strych. Sulph., 1/100, 1/50 gr.	725	
Sulphur Coll., 5 Cc. (1 in		
1,000)	362	
Testicular Ext. c. Glyceroph.,		
2 gr., c. Strych., 1/60 gr.,		
10 m.	932	
Thiosinamin, Comp., 1 & 2 Cc.	695	
with Antipyrin = 15 m...	695	
Thorii Aceto-coum., 10 m...	31	
Trypsin, 30 m. et c. Cocaina,		
1/10 gr.	621	
Tuberculin Dilutions	884 <i>et seq.</i>	
Tylmarin Thorium, 10 m. . .	31	
Urea-Quinine and c. Eucaïne	671	
Water Distilled	217	
STERULES, INHALATION ..	718	
Amyl Nitrite, 1 to 10 m. . .	146	
Chloroform, 10, 20, 30 and		
60 m., also 1, 2, 4 oz.		
(Anæsthetic)	285	
Ether, 1 and 2 oz. . . .	106	
Ethyl Iodide, 5 m. . . .	114	
„ c. Chlorof.	115	
„ „ „ et Menthol	115	
STERULES, IONIC Cocaine,		
Copper, Lithia, Magnes,		
Mercury, Pot. Iod., Quin.		
HCl. Ac., Sod. Chlor., Zinc	719, 286	
STERULES, LOTION for		
diluting 1 to 1 pint:—		
Hydrarg. Perchlor. . . .	465	
„ Biniodid	459	
„ Oxycyanid.	455	
Potass. Permang. . . .	538	
Saline Soln. (for 2 pints)	698	
STERULES, OPHTHALMIC ..	718	
Adrenalin Chlor. . . .	930	
Argyrol, 10 and 25 % . .	170	
Atrop. Sulph., 1 % . . .	214	
„ Sulph., $\frac{1}{2}$ % with Cocaine		
(HCl.) 2 $\frac{1}{2}$ %	214	
Cocaine HCl., 10 gr. to oz.		
& tube form)	324	
Dionin, 5 %	548	

NAME.	DOSE.	PAGE
Fluorescein et Sod. Bic. . .	635	
Holocaine, 1 %	331	
Homatropine, HBr., 1 % . .	217	
(et c. Cocaine, 2 $\frac{1}{2}$ %) . .	217	
Physostigmin., 4 gr. to oz.	642	
„ 1gr., et c. Coc., 4 gr...	642	
Pilocarpine Nit., 0.5 % . .	522	
Protargol, 10 and 25 % . .	170	
STERULES, LARGE (TUBE		
FORM) 10 min., Cocaine HCl.,		
5, 10 %	324, 718	
Steven's Consump. Cure . .	578	
Stibium Sulph.	151, 26	
Stibnite	150	
Stillingia, 30 gr.	825	
Stinging Nettle	38	
St ockholm Tar, 2 to 10 gr.	651, 136	
Stokes' Liniment	647	
Stomach Contents, Exam. . .	459	
„ Tubes	265, 459	
Stomachic balsam	810	
Stomonal	305	
Stomoxys, 531; Stone		
Root	791	
Storax	825	
Storks-bill	796	
Stovaine, $\frac{1}{8}$ to $\frac{3}{4}$, max. 2 gr.,		
336; Stovaine-Dextrin, 337;		
Gargle, Ointment Pastils,		
Snuff, Solution (internal) . .	339	
Stovaine-Glucose	336, 57	
Stovaine-Strychnine . . .	338	
<i>Stramonium</i>	719, 151	
Strawberry = <i>Fragaria Vesca</i> L.		
Streptococcus & Serum	874 & 510	
Streptococcus Conglomeratus..	875	
„ fæcalis	343, 530	
„ Lebeis	5	
„ Rheumaticus	872	
Strong's Blood Method . .	382	
<i>Strontii Brom.</i> (Exsic., 4-24		
gr., 720); 5-30 gr. 720, 43		
„ Carb., 5 to 30 gr. . . .	720	
„ Cinnam., 2 to 5 gr. . .	28	
„ Glyceroph., 3 to 8 gr. . .	44	
„ Iodid., 5 to 20 gr. . . .	720	
„ Lactas, 5 to 30 gr. . . .	721	
„ Oleas, 5 to 20 gr. (?) . .	586	
„ Salicyl., 5 to 20 gr. . .	721	
<i>Strophanthi Semina</i> ,	721	
Assay	146	
„ Phys. Standardised. 722,		
146		
Strophanthin, 1/300 to 1/100 gr.	721,	
147		
Struxine	112	
<i>Strychnina</i> , 1/64 to 1/16 gr. . .	723	
„ Tests.	111, 226, 250	
<i>Strychninæ</i> Acetas, 724;		
Arsenas, 1/64 to 1/16 gr.,		
724; Cacodylas, 1/30 to 1/10gr.		
183; Formas, 1/64 gr., 39;		
Glyceroph., 1/64 to 1/20 gr.,		
d .. 724;		

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Strychnin Hypophosph., 725 ;			'Sunic' Coil		286
Nitras, Phosph. Acid, Sulph.			Screens		287
and Sulph. Acid, 1/64 to			Sunlight		305, 362
1/16 gr., 725; Valerianas,			Superol		306
1/25 to 1/10m.		726	Suppositories, 731; Hollow		
Strychnos, <i>var.</i>	579, 580,	111	429; Mass for hot Climates,		
Styptic Colloid, 344; Gelatin,			611, 732, 770; See also 252;		
930; Wool		410	Vaginal		429
Stypticin, 1/4, 1/2 gr., or if urgent			Suppos. Acidi Borici, 3 gr. ..		11
up to 4 gr.		554	" <i>Carbol.</i> , 1 gr. ..		19
Stypticin Gauze and Wool ..		555	Suppos. Acidi Lact. B. ..		7
Styptol, 3/4 gr. incr. ..		555	" " <i>Tannici</i> , 3 gr., and		
Styracol, 5 to 15 gr. ..		377	with Morph., 1/4 or		
<i>Styrax Prep.</i> , <i>av.</i> U.S., 15 gr. .		825	Opium, 1 gr. .. 99,	100	
Subcutin		335	Adrenalin, 10 m. ..		930
Sublimate Disinf., 465; Mala-			" <i>c.</i> Formidin Co-		
chite Green Soln., 309; Spirit,			cain & Hamam... ..		930
466; Gauze, Wood Wool ..		466	Suppos. Aloes		132
Succinic peroxide, 2 gr. ..		97	" Argyrol		170
Succinimide		472	" Aristol 1 gr. ..		495
Succinum		825	" Atropinæ et Plumbi Iod. .		215
Succus Agavæ Conc. 1/2 oz. ..		817	" Bellad., 1 1/4 gr. ..		223
" <i>Allii</i> , 10 to 30 m. ..		777	" " et Morph., 1/4 gr. ..		223
" Alterans, 1 dr. ..		825	" Bismuthi Oxychl., 10 gr. .		230
" <i>Ari</i> , 1 dr. ..		781	" " <i>Salicyl.</i> , 10 gr. ..		231
" <i>Conii</i> , B.P. '98, 1 to 2 dr.			" " <i>Subnit.</i> , 10 gr. ..		
" <i>Galii</i> , 1 to 2 dr.		798	" Chloral, 5 gr. ..		277
" <i>Limonis</i> (<i>see</i> Neutralisa-			" Chrysarobin, 1 1/4 gr. ..		288
" " tion Table). ..			" Cocainæ, 1/4 to 1/2 gr., et c.		
" <i>Mori</i> , 1 dr. ..		809	" " Morphina, 1/4 gr. ..		325
" <i>Papav. Somnif.</i> (<i>Cap.</i>			" Cocainæ Vaginal, 2 gr. ..		325
" <i>Inspiss.</i> (<i>and Pulv.</i>),			" Collargol (& Co.), 2 1/2 gr..		170
" " 1/2 to 2 gr.		604	" Cubebæ, 10 gr. ..		378
" <i>Scopariæ</i> , 1 to 2 dr. ..			" Eucalypti, 5 gr. ..		796
" <i>Sempervivi</i> , 5 to 15 m		822	" Euphyllin, 5 gr. ..		738
" <i>Taraxaci</i> , 1 to 2 dr. ..		827	" Gallæ, 5 gr., et c. Opio, 1		
" <i>Urticæ</i> , 1 to 4 dr., incr..		38	" " gr.		429
<i>Sucrose</i> , Sugar		685	" <i>Glycerini</i>		235
Sudan Red		311	" Hæmorrhoidal		442
Sugar Cane, 685, 142; Chinese			" Hamam. Co.		443
824; Coating, 643; Grape,			" Hamamelin, 1 and 3 gr..		444
425; Inverted, 686; of lead		653	" " et Hydrarg. Co. ..		444
Sugars, Bacteriological ..		551	" Hamam., <i>Conii</i> et <i>Eucain</i>		449
Sulfarsenol		40	" Hydrargyri		471
Sulphaqua Charges		730	" " <i>Subchlor.</i> , 1 gr. ..		489
<i>Sulphonal</i> , 10 to 30 gr. ..	726 &	361	" Ichthyol, 3 gr. ..		506
" Reversed		727	" Iodex.		494
Sulphone-ethyl-methane ..		727	" <i>Iodoformi</i> , 1, 3, 5 gr. ..		755
Sulphondichloramino-benzoic			" " <i>c.</i> Eucalyp. Oil, 5 m.		545
Acid		64	" Malourea, 4 to 8 gr. ..		633
Sulphonmethanum		726	" <i>Morphinæ</i> , 1/4 gr. ..		449
Sulphur		728	" Nutrient		633
Sulphur, Lime Depilatory ..		256	" <i>Olei Cinerei</i>		671
" Colloidal	350, 362,	729	" <i>Opil</i> , 1 gr.		819
Sulphur Dioxide and Trioxide	98,	14	" <i>Pep. Beef.</i>		689
Sulphuretted Hydrogen ..		730	" <i>Quassia Ext.</i> , 1/4 gr. ..		591
Sulph. Chlor., Hypochlor. ..		730	" <i>Quin. HCl.</i> , 5 gr.		671
" Iodidum		730	" " Hydroch. Carbam.		
" Lotum		729	" " 5 gr.		819
" <i>Præcip., Sublim.</i> , 20 to			" <i>Ranunculi</i>		689
" " 60 gr.		728	" <i>Santonini</i> , 3 gr. ..		
Sumach, 15 gr.		819	" <i>Sod. Chaulmoograte 'A,'</i>		
Sumbul Radix, <i>av.</i> 30 gr, ..		826	" " 1 to 3 gr.		591
Sundew		794	" <i>Supra - renal</i> (et c.		
Sunflower Oil		597	" " Morph.)		925

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Suppos. Thymol Iodide ..		495	<i>Syrupus Chloral</i> , $\frac{1}{2}$ to 2 dr. ..		277
„ Trypsin		621	„ Cocainæ, 1 dr. ..		325
„ Veronal, 4 to 8 gr. ..		755	„ Cocillanæ Co., $\frac{1}{2}$ to 1 dr. ..		791
Supplementary List ..		771, 148	„ <i>Codeinæ Phosph.</i> , $\frac{1}{2}$ to 2 dr. ..		340
Supra-renal Gland, Ext. Dry,			„ Cyllin, 10 to 60 m. ..		35
Liq., Suppos. (et c. Morph., $\frac{1}{2}$			„ Dusart, 2 to 4 dr. ..		69
to 3 gr.), Inj. (Hypod.),			„ Eastoni, $\frac{1}{2}$ to 1 dr. ..		417
Snuff, Spray, Tabellæ, Tab-			„ „ Liq. pro., 9-18 m. ...		418
lets. 1 or more, Ung., 924 et			„ Eucalypti Gum, $\frac{1}{2}$ -1 dr. ...		796
seq 152, (Assay)		159	„ Ferri et Quin. Cit., 1 dr. ..		665
Supra-renin., Tabs., 1/60 gr.;			„ „ <i>Iodidi</i> , $\frac{1}{2}$ to 1 dr. ..		415, 73
Bitart. and HCl. ..		926 & 154	„ „ <i>Phosph.</i> , $\frac{1}{2}$ to 1 dr. ..		417
Supsalvs.		200	„ „ <i>Phosph. Co.</i> , $\frac{1}{2}$ to		
Surgeon's Agaric		778	2 dr. ..		417 & 73
Surgical Dressings Sterilisa-			„ „ <i>Phosph. c. Quin et</i>		
tion		266	<i>Strych.</i> ('Easton'),		
Surgical Lubricant		16	$\frac{1}{2}$ to 1 dr. ..		417
Surgical Soap, 691; Solvent ..		621	„ Ficorum, 1 to 4 dr. ..		393
Sutures		526	„ Formatum Co., 1-2 dr. ..		39
Swabs, Steriloid, Triang. ..		439	„ <i>Glucosi</i>		643
Sweet Gale, 784; Vernal Grass		780	„ Glyceroph. Robin, 1 to		
Sydenham's Laudanum, 5 to			4 dr. ..		46
20 m.		608	„ „ Co., 1 to 2 dr. ..		45
Syls, 1 to 2 drachms :—		434	„ „ e. Format., 1 dr. ..		46
Amygd., Anethi, Anisi			„ Heroin, 1 to 2 dr. ..		548
Aurant. Amar., Aurant.			„ Hypoph., 2 dr. ..		640
Flor., Carui, Caryoph.,			„ „ Co., $\frac{1}{2}$ to 2 dr. ..		639
Cinnam. Fœniculi, La-			„ „ Fellows', 1 to 2 dr. ..		639
vand., Limonis, Menth.			„ Iodo-Tannic, $\frac{1}{2}$ -2 dr. ..		501
Pip., Menth. Vir., Myrist.,			„ Ipecac.		511
Pimentæ, Pini, Rosæ.			„ Kolæ Co., 1 to 2 dr. ..		248
Sassaf., Thymi, Vanillæ.			„ Laetucarii, av. 2 dr. ..		486
Sylphion, 828; Symphytum var.		826	„ <i>Limonis</i> , $\frac{1}{2}$ to 1 dr. ..		806
Synergism		550	„ Mori, 1 dr. ..		809
Synol Soap		691	„ Neurotonique, 2 to 3 dr. ...		665
Synthetic Notes in relation $\frac{3}{4}$			„ Picis Liq., 1 to 2 dr. ..		651
to Physiological Effects ..		255	„ „ e. Codeina, $\frac{1}{2}$ to 2 dr. ..		652
Syphilis		191, 448, 510	„ Pilocarpin et Pot. Brom.,		
„ Arsenic & Mereury			1 dr. to 1 oz. ...		523
comb. treatment ..		201	„ Pini Pumil., 1 dr. ..		648
„ Diagnosis Methods		394, 510	„ Pini Terpin et Heroin, 1 dr. ..		648
„ McDonagh's Test ..		523	„ <i>Pruni Virg.</i> , $\frac{1}{2}$ to 1 dr. ..		816
„ Salvarsan in ..		191 et seq.			& 140
„ War Office Treatment		202	„ Rami, acc. to age ..		241
„ Wassermann's Test ..		515	„ Rhamni, $\frac{1}{2}$ to 1 dr. ..		797
„ and Parasyph in rela-			„ <i>Rhei.</i> $\frac{1}{2}$ to 2 dr. ..		684
tion to Wass. Reactn.		524	„ „ Aromat., av. 2 dr. ..		684
Syringes, 266; Hypod ..		323	„ <i>Rhæados</i> , $\frac{1}{2}$ to 1 dr. ..		770
Syringe Sterule		718	„ <i>Rosæ</i> , $\frac{1}{2}$ to 1 dr. ..		819
<i>Syrupus</i>		686	„ <i>Scillæ</i> (& Co.), 30 to		
„ Acaciæ		771	60 m.		821
„ <i>Acid Hydriodic</i> , 30 to 60 m.		508	„ Senegæ, 1 dr. ..		822
„ Aegle Marmelos Co., $\frac{1}{2}$ to			„ <i>Sennæ</i> , $\frac{1}{2}$ to 2 dr. ..		693
1 oz.		784	„ Sulphatum, 4 dr. ..		256
„ Apomorph. HCl., $\frac{1}{2}$ to 1 dr.		165	„ Tann-Iodo-phosp., $\frac{1}{2}$ to		
„ <i>Aromat.</i> , $\frac{1}{2}$ to 1 dr. ..			2 dr.		501
„ <i>Aurantii</i> , $\frac{1}{2}$ to 1 dr. ..		218	„ Thymi, 1 to 4 dr. ..		828
„ Benzaldehydi Hydro-			„ <i>Tolu.</i> , $\frac{1}{2}$ to 1 dr. ..		783
cyanicus, $\frac{1}{2}$ to 1 dr. ..		816	„ Triplex, 1 to 2 dr. ..		418
„ Bromoformi, $\frac{1}{4}$ to 1 oz. ...		240	„ Trium Phosph., 1 to 2 dr. ..		417
„ Calcii et Fe. Laetoph.,			„ <i>Urginæ</i> , $\frac{1}{2}$ to 1 dr. ..		829
$\frac{1}{2}$ to 1 dr. ..		69	„ <i>Violæ</i> , ad lib. ..		831
„ „ <i>Lactoph.</i> $\frac{1}{2}$ to 1 dr. ..		69	„ <i>Zingib.</i> , $\frac{1}{2}$ to 1 dr. ..		768
„ Camph. Co., 1 dr. ..		608	Sys-Specific		248
„ <i>Cascaræ Aromat.</i> , $\frac{1}{2}$ -2 dr.		269	Sysimbrium, 796; Systogen ..		399

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NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
T. A. B. Vaccine		900	Tablets, Compressed,—732—continued		
T.N.T. and Webster's Test for		305	Acid Lactic Bacilli, 3 to 6 <i>p.d.</i>		60
Tabaci Folia		811	Aconiti = 2½ m. Tincture ..		100
Tabaiaco		604	Adalin, 5 gr.		75
Tabardillo		554	Aldemint		131
TABELLÆ, Chocolate Tablets—		736	Adrenalin, 1/200 gr		922
„ Antiasthmatic., 1 to 4 <i>t.d.</i> ..		560	„ 1/300 gr., with Cocaine		
„ Antimonii Sulph. (0.01 G) ..		151	½ gr.		929
„ Apomorph., 1/100, 1/50 gr. ..		165	Aldoform		131
„ Bismuthi et Pepsin, <i>aa.</i>			Alkagen, 1 to 3		530
3 gr.		228, 633	Aloes et Ferri, 4 gr.		132
„ „ „ c. Cascara Ext.			Aloin, 1/10 and ½ gr.		133
1 gr.		228	„ Compound		133
„ Caffeinæ Cit. 1 gr.		245	Alupon, ½ gr.		609
„ Cocaina, 1/20 to ½ gr.		325	Alypin, ½ 5/6 and 3½ gr. (and		
„ Diacetyl Morph. HCl, 1/10			c. Suprarenin)		332
gr.		548	Ammon. Brom., 5 and 10 gr.		138
„ Digitalin, 1/10 gr., et			„ Chlor., 3 and 5 gr.		139
Nitroglycerin, 1/100 gr. ..		392	„ „ 3 c. Borax, 2 gr. ..		139
„ Erythrol Nitratis ½, ½,			„ „ c. Glyc. Ext., 3 gr.		139
½, 1 gr. 1 or 2		401	„ Quinine and Comp. ..		677
„ Exalgin, ½ gr.		2	Anticonstipation		139
„ Glonoini, 1/130 gr.		558	Antifebrin, 3 gr. (et c. Caf-		
„ Glycyrrhizæ, <i>p.r.n.</i>		433	feine, 1 gr.)		1
„ Lecithin, ½ gr.		525	Antipyrine, 2½ and 5 gr. (et		
„ Mannitol Nit., 1 gr.		402	3 gr. c. Caffeine, 1 gr.) ..		315
„ Menthol, 1/5 gr.		540	Antisclerosin, 6 <i>p.d.</i>		701
„ Nitroglycerini, 1/600,			Antiseptic (Thymol, etc.) ..		
1/400, 1/200, 1/100, 1/75,			Antityphoid		710
1/50, 1/25 gr. and 1			Aphrodine		831
mgr., 1 or 2		558	Apomorphine, 1/100, 1/50 gr.		165
„ Nitroglyc., 1/100 gr. c.			Arsamin, 1 gr.		185
Caffeine, 1 gr.		559	{ Arsenic, 1/60 gr.		
{ Nitroglyc. 1/150 to 1/100 } ..		560	{ Iron Hypoph., 2 gr.		176
{ Strych., 1/100 to 1/20 } ..			{ Quin. Ac. Sulph., 1 gr. ..		
{ Nitroglyc., 1/200 to 1/100 } ..		560	Arsenious Acid, 1/100, 1/50,		
{ Thyroid., ½ to 3 gr. } ..			1/20 gr.		174
„ Nitroglyc. Co., 1 or 2		560	„ 1/64 gr., with Mer-		
„ Papain, 2 gr.		622	curic Chloride, 1/64 gr.		175
„ Pepsinæ, 3 gr.		633	Aspirin, 5 and 8 gr., and		
„ „ et Caffeine, 1 to 2 ..		633	with Phenacetin, 2½ gr. ..		88
„ „ et Strychninæ		633	Atrop. Sulph., 1/100 gr. ..		213
„ Phenolphthalein, ½, 2 and			Benzonaphthol, 5 gr.		552
4 gr.		634	Benzosol, 5 gr.		376
„ Phenolphr., 4 gr., c. Ext.			Betanaphthol, 3 and 5 gr. ..		552
Rhei, 3 gr.		634	„ 5 grains, c. Phenolph-		
„ Quin Tannat., 1 gr.		678	thalein, 3 gr.		552
„ Sodii Nitritis et Sodii			Bismuth Carb., 5 gr.		225
Iodidi.		708	„ Salicyl., 5 gr.		231
„ Sodii Nitritis Co.		708	„ Subnit., 5 and 10 gr. ..		234
„ Strophanthi Tinct., 2 m. ..		722	„ et Pepsin, <i>aa</i> 3 gr.		228
„ Suprarenal Ext., ½ gr. ..		925	„ Pepsin & Cascara, one		
„ Trilactine		70	<i>t.d.</i>		228
„ <i>Trinitrini</i> , 1-130 gr. ..		559, 94	„ Pepsin and Charcoal,		
2 gr. each			4 gr. c. Arsen. 1/64		
Tablets, Compressed—Tabletæ,			gr.		408
732, 733. In demand are:—			Blaud's Pill, 4 and 8 gr. ..		408
Acetanilide, 3 gr., et c. Caf-			„ „ 4 gr. c. Arsen. 1/64		
feine, 1 gr.		1	gr.		408
Aceto-Salicyl. Acid. 5, 8 gr.			Bon Voyage		47
(and with Phenacetin also			Boric Acid, 5 gr.		9
with Dover Pdr.)		88	Brominol = 9 gr. Pot. Brom. ..		239
Ac. Benzoic Co. = Benzoic			Bromural, 5 gr.		758
Acid, ½; Codeine, 1-10;			Butyl-Chloral c. Gelsem. ..		242
Ipecac., 1-10; Menthol,					
1-10; Red Gum, ½ gr.					

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE
Tablets, Compressed—732—<i>cont.</i>		
Caffeine, 1 gr. c. Antipyrin	3	245
gr.	245
„ Cit., 2 gr.	245
„ H Br., 2 gr.	245
„ 1 gr. c. Phenacetin,	4 gr.	245
Calc. Lact., 5 gr.	68
Calc. Sulph., $\frac{1}{4}$, $\frac{1}{2}$, 1 gr.	253
Calomel, 1/10 to 5 gr.	470
Calculusol	6 1
{ Camphor, $\frac{1}{4}$ gr.	259
Quin. Ac. Sulph., 1 gr.	260
Camph. Monobr., 1 gr.	259
Camphor., $\frac{1}{4}$ gr. c. Quin., 1 gr.	261
Cannabis=5 m. Tinct.	10
Carbolic Acid, $\frac{1}{4}$, $\frac{1}{2}$ gr.	271
Cascara Ext., 1 to 5 gr.	272
Catha Ext., $2\frac{1}{2}$ gr.	913
Cerebral, 5 gr.	307
Chinosol, 5, 8, 15 gr.	278
Chloralamide, 5 gr.	277
Chloral Hyd., 5 and 10 gr.	656
(to be dissolved)	340
Cholelysin, 690; Chologen	550
Codeine, Phosph., $\frac{1}{4}$ gr. and $\frac{1}{2}$ gr.	714
Codeonal, $2\frac{1}{2}$ gr.	714
Colalin, $\frac{1}{8}$ and $\frac{1}{2}$ gr.	714
„ Laxative, $1\frac{1}{8}$ gr.	639
Col. Co.=4 gr. pill. (<i>Off.</i>)	554
Comp. Hypophosphites	555
Cotarnin HCl., $\frac{3}{4}$ gr.	913
„ Phthalate, $\frac{3}{4}$ gr.	446
Corpus Luteum, 1 gr.	447
Cystazol, 10 gr.	757
Cystoformin, 15 gr.	932
Dial, $1\frac{1}{2}$ gr.	391
Didymin, 5 gr.	737
Digitoxin, 1/250 gr.	758
Dinner, 655; Diuretin, 5 gr.	511
Dormigene, 5 gr.	914
Dover's Powder, 5 gr.	419
Duodenal Ext.=5 gr.	419
Easton Syrup= $\frac{1}{2}$ & 1 dr. (& c. Arsen.)	398
<i>Effervescing, see 'Vescettes.'</i>	..	398
Ergotin, 1, 2 and 3 gr.	64
„ Scenecin Co.	331
Eserine and Trunczek's Serum	406
Eucaïne-β, 1/10 gr.	679
Euonymin, 1/6 to 4 gr.	2
Euquinine, 8 gr.	421
Exalgine, $\frac{1}{2}$ gr.	274
Ext.-Filicis, 3 m.	178
Fæxin Ext., 3 gr.	176
Ferri Arsenas, $\frac{1}{8}$ gr.	408
Ferri (Blaud), with Arsen.	665
1/64 gr.	508
Ferri Carb., Sacch., 5 gr.	—
„ Quin. Citr., 3 gr.	—
Ferro-Sajodin, $7\frac{1}{2}$ gr.	—
Ferrum Redactum, 2 gr.	—

NAME.	DOSE.	PAGE
Tablets, Compressed—732—<i>cont.</i>		
Formaldehyde Disinfectant	130, 359	
„ $\frac{1}{4}$ gr. c. Sacch., Lact., 2 gr., internal	131, 24	
Formamint	131
Gland ('Three' and 'Four'), 1 or 2	935, 936	
Glyceroph. Co.	46
Grey Powder, $\frac{1}{4}$ to 3 gr.	—
Grey Powder, 1 gr. and Dover's Powder, 1 gr.	—
Guaiaicol Benz., 5 gr.	376
„ Carb., 5 gr.	376
Guaiaic. & Sulph., aa 3 gr.	442
Halazone	64
Hexamin, 5 gr.	446
„ & Lith. Benz.	446
Hyd. Iodid. Flav., $\frac{1}{8}$ gr.	459
„ „ Rub., 1/20 gr.	456
„ „ Vir., $\frac{1}{8}$ gr.	459
„ Perchlor., 1/100, 1/32, 1/16, & 1/10 gr.	466
„ Subchlor., 1/10 $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 3, 4, and 5 gr.	470
Hydrastine Compound	476
Hyperol, 479; Ichthyol, $2\frac{1}{2}$ gr.	488
Iodinol 3 gr. of 25%	499
Iodoprotein, 10 gr.	507
Iodostarin	509
Ipecac., 1/20, 1/10, $\frac{1}{4}$, 5 gr.	510
„ Alcresta, 10 gr.	520
Iron Carb. Sacch., 5 gr.	408
Iron Quin. Cit., 3 gr.	665
Kermetis, 0.01 Gm.	151
Lactic Acid Bacilli, 6 <i>p.d.</i> 69, <i>See also</i>	..	4
Lactobacilline	69
Laverain	680, 140
Lecithin, $1\frac{1}{2}$ gr.	525
Lithium Carb., 5 gr.	528
„ Citrate, 5 gr.	528
Livingstone Rousers	678
Lymphatic Gland	915
Magnes. Perox.	480
Magnes. Sulphis, 5 gr.	98
Malonurea, 5, 8, 10 gr.	755
Manganese Diox., 2 gr.	535
Marienbad	133
„ Salt, 60 gr.	712
„ Anti-obesity	712
Migralgine, 8 & 15 gr.	247
Mucin, 5 gr.	916
{ Nitroglycerin, 1/50 gr.	4 <i>tis</i>	560
{ Sod. Iodid., 15 gr.	<i>horis</i>	
{ Liq. Arsenical 2 m.		
(<i>See also</i> Tabellæ, 558 <i>et seq.</i>)	..	
Nitropropiol (Sugar Test)	404
Novocain with Adrenalin var.	333
Nuclein, 1 gr.	274
Omnopon, 1/6 gr.	609
Opium, $\frac{1}{2}$, 1 gr.	607
Orchitic Subst., 5 gr.	932
Ovarian, 5 gr.	916
Ox Bile (Stearettes), 5 gr.	407

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE
Tablets, Compressed—732—<i>contd.</i>		
Pancreatin and Soda	..	618
Papain, 2 and 5 gr.	622
Paraform	130
Pavinol, 5 m.	598
Pepsin, 3 gr.	633
„ 3 gr. et Caffeine, 2 gr.	..	633
Peptonic (Pepsin, Pancreatin, Calcium Lactoph., each 1 gr.)		
Phenacetin, 4, 5 & 10 gr.	312
„ 4 gr., c. with Caff., 1 gr.	..	312
„ 2½ gr., and Sulphonal, 2½ gr.	312
Phenalgine, 5 gr.	2
Phenolphthalein, ½, 2, 4 gr.	..	634
„ Comp.	634
Pichi Ext. and Comp.	814
Pilocarpin Nit., 1/10, 1/5 gr.	..	522
Piperazine, 5 gr.	650
Pituitary Dried, 1 gr. entire gland	919
Placenta = 0.25 gm.	158
Podoph., 1/10 to 1 gr.	655
Potass. Bicarb., 5 gr.		
„ Brom., 5, 10 gr.	658
„ Chlor., 5 gr.	659
„ „ 3 gr., c. Ammon. Chlor. 1 gr., c. Borax, 2 gr. et c. Borac. et Cocaina	659
Pot. Iodide, 5 gr.	661
„ Permang., 1, 2, 3 gr.	538
Proflavine, 1.75 gr.	299
Propional, 1½ gr.	757
Pulv. Cret. Arom. c. Op., 5 gr.	..	607
Quin. Acetyl-Salicyl., 3 gr.	672
„ Ethyl-Carb., 8 gr.	679
„ HBr. 3 and 5 gr.	666
„ „ 3 gr. c. Phenac., 5 gr.	..	666
„ HCl., 1 to 5 gr.	668
„ „ Acid, 1, 3, 5 gr.	670
„ Rhei Co.	678
„ Salicyl., 3 gr.	672
„ Sulph., 1 to 5 gr.	676
„ „ Acid ½ to 5 gr.	678
„ „ Ac. 1 gr. c. Camph., ½ gr.	259
„ „ Ac. 1 gr. Camph. 1/5 gr. et c. Aconite Tinct., 1 m.	677
„ „ Camph., Morph. et Atrop.	677
Red Bone Marrow, 3 gr.	912
Regenerative, 6 <i>per diem</i>	701
Rennet, 630; Rennin, 1 gr.	630
Resorcin, 3 gr.	682
Rhubarb, Soda and Ginger	684
Saccharin, Full & Half Str.	685
Salicin, 5 gr.	93
Salipyrin, 5 gr.	317
Salol, 5 gr., 93; Salophen, 5 gr.	..	95
Santalol, 3 m.	601
Santonin, 1, 2 & 3 gr.	688
Sidonal, New, 7½ gr. each	650

NAME.	DOSE	PAGE
Tablets Compressed—732—<i>contd.</i>		
Soda Mint (Sod. Bicarb., Am. Carb., & Mint).		
<i>For Effervescing Compounds see 'Vescettes.'</i>		
Sodii Acid Sulph.	711
„ Benzoate, 2 gr.	711
„ Bicarb., 5 gr.	711
„ Bisulph. for Baths	702
„ Bromid., 5 gr.	702
„ Chlor. et Borac	705
„ Citras. 5 & 10 gr. ..	569, 706	
„ Desoxycholate	715
„ Iodid c. Sodii Nitrite, 3 gr. with ½ gr., also 5 gr. with 1 gr.	708
„ Nitris, 2½ gr.	707
„ „ Co.	708
„ Perborate Mouth	138
„ Salicyl., 3 & 5 gr., and Nascent	86
Solurol, 4 gr.	933
Spinal Cord, 2½ gr.	913
Stannoxyd	824
Strontium Brom., 5 gr.	720
Strophant. Tinct., 2 & 5 m.	722
Strych. Sulph., 1-60 to 1-30 gr.	..	725
Strych. c. Nitroglyc. (Tabellæ)	..	560
Stypticin, ¼ gr.	554
Styptol, ¼ gr.	555
Sulphonal, 5 gr.	727
Sulph. Præcip., 5 gr., c. Pot. Acid. Tart., 1 gr.	729
Supra-renal, ½ & 1 gr. Dry Substance	924
Syr. Easton = ½ & 1 dr.	419
Testicular Substance	932
Theobrom. Sod. Salicyl, 5 gr.	..	737
Theocin Sod. Acet., 4 gr.	739
Theophylline, 4 gr.	739
Thiocol, 5 gr.	377
Three Gland	936
Thymine Acid, 4 gr.	933
Thymoform	746
Thymol Carb., 10 gr.	746
Thymus Gland, 3 & 5 gr.	932
Thyroglandin, 3 gr.	935
Thyroid (Standard), 1½ & 5 gr.	..	935
„ Comp. (3 and 4 gland).	935
Tinct. Aconit., 2½ m.	103
„ Bellad., 2 & 5 m.	224
„ Cannab. = 5 m.	261
„ Nuc. Vom., 5, 10 m.	580
„ Opii, 5 & 10 m.	608
„ Quin. Ammon. = 1 dr.	677
„ „ Comp.	677
„ Strophanth., 2 & 5 m.	722
Trilactine, 3 to 6 <i>p.d.</i>	69
„ Intestinal, 3 to 6 <i>p.d.</i>	69
Trional, 5 gr.	728
Trivalin	762
Truncsek's Serum	701
Tylcalsin, 8 gr.	90
Tyllithin, 8 gr.	91
Tylmarin, 5 gr.	31

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Tablets, Compressed—732—<i>contd.</i>			Tablets Hypodermic—<i>contd.</i>		
Uranium Nit., 1 gr. . . .	..	752	Sclerotic Acid, 1/16 gr. . .	..	401
Urethane, 5 gr. . . .	..	759	Scopola. Morph. (and with		
Urosin, 8 gr. . . .	..	665	Atrop.) . . . .	..	484
Urotropine, 3, 5, & 7½ gr.;			Sparteine Sulph., ½ gr. . .	..	715
Eff., 5 gr. . . .	..	446	Strophanthin, 1/500 gr. . .	..	722
Varium . . . .	..	916	Strychnine Nit., and Sulph.		
Veronal, 5, 5, and 10 gr. . .	..	755	1/100 to 1/30 gr. . . .	..	725
Vesalvine, 5 gr. . . .	..	446	Tropacocaine HCl., 1/30 gr.	..	329
„ S, 5 gr. . . .	..	447	Tyramine, . . . .	..	400
Water Sterilising . . . .	..	710	Tablets, Ophthalmic. <i>Vide</i> La-		
Yohimbine HCl., 1/13 gr. . .	..	831	mellæ. . . .		
Zinc Oxide, 2 gr. . . .	..	765	Tablet Triturates . . . .	..	734
Tablets, Hypodermic.. . .	..	734	Tablogestin, 3 Tabs. . . .	..	620
<i>Chiefly in demand are:—</i>			Tachiol, 169; Tænia, 420, 688,		
Aconitine Nit., 1/640 gr. . .	..	104	781; and Worms, Therap. Ind.		
Adrenalin, 1/300 gr., c. Cocaine			Taffetas Film . . . .	..	436
HCl., ½ gr. . . .	..	929	Taka-diastrase, 1 to 5 gr. . .	..	535
Adrovaine (Adrenalin 1/250 c.			Talc (and Talc. Purif.) . .	137, 90	
Stovaine, ½ gr.) . . . .	..	936	„ <i>per os</i> 1 to 2 dr. . . .	..	90
Apomorph. HCl., 1/20, 1/15,			Tallquist Scale . . . .	..	380
1/10 gr. . . .	..	165	Tamarind, 1 to 8 dr. . . .	..	827
Atropine Sulph., 1/200 to 1/50			Tambach's Test . . . .	..	100
gr. . . .	..	213	Tampons, Gauze	437, 734	
Atrop. c. Morph. . . .	..	214	Tamus, 827; Tanacetum . .	..	827
Caffeine Sod. Salicyl., ½ gr. .	..	246	Tannalbin, 8 to 15 gr. . .	..	100
Cocaine Hyd., 1/10-½ gr. . .	..	324	Tannalbin Insolubile . . .	..	100
Codeine Phosph., ¼ and ½ gr.	..	340	Tannigen, 5 to 15 gr. . .	..	100
Curare, 1/12 gr. . . .	..	793	Tannin, 5 to 10 gr. . . .	..	99
Diamorphine HCl., 1/24, 1/12			Tannoform . . . .	..	100
gr. . . .	..	548	Tanret's Reagent . . . .	..	80
Digalen . . . .	..	392	Tansy, 827; Tantalum, Tan-		
Digitalin, 1/10 gr. . . .	..	391	talite, 827; Tar, 2 to 10 gr. .	..	651
Ergamine, 1/65 gr. . . .	..	399	Tar Acids, 33; Oils . . . .	..	33
Ergotinine Cit., 1/200 to 1/100			Tar Spirit	651, 136	
gr . . . .	..	398	Taraktogenos . . . .	..	587
Ergotoxine, 1/100 gr. . . .	..	398	Taraxacum (30 to 120 gr.) .	..	827
„ 1/100 c. Morph. ½ . . .	..	398	„ Cocoa, ½ oz. . . .	..	827
„ 1/100 c. Strych., 1/20 . .	..	398	Tartar Emetic . . . .	..	156
Heroin HCl., 1/24, 1/12 gr. . .	..	548	Diaphoretic, 1/24 to ½ gr.		
Homatropine HBr., 1/200 gr.	..	217	Emetic, ½ to 1 gr. . . .		
Hyd. Perchlor., 1/60, 1/50, &			Tartarus Boraxat, .30 gr. . .	..	12
1/30 gr. . . .	..	466	Tartrazine . . . .	..	456
Hyoscine HBr., 1/400 to 1/75			Tatcho . . . .	..	578
gr. . . .	..	482	Tattoo Marks to remove . .	..	1008
Hyoscine Comp. . . .	..	484	Taurine . . . .	..	95
Hyoscyamine Sulph., 1/100,			Taurocholalbumin . . . .	..	367
1/50 gr. . . .	..	487	Taxine (Taxus), 1/100 to 1/60		
Morphinæ mec., ⅓ and ¼ gr. . .	..	546	gr. . . .	..	828
„ HCl., ½ to 1 gr. . . .	..	545	Tea, 243, 44 ; Tea Seed Oil, 121 ;		
„ Hypophosph, ¼, ½, ½ &			Teel Oil . . . .	..	603
1 gr. . . .	..	546	Teleradiography . . . .	..	291
„ Sulph., ½ to 1 gr. . . .	..	546	Telfaria, 828; Tenaline, 781;		
„ c. Atropina	213, 214,	546	Tenax, 651; Tephrosia . .	..	798
„ c. Nitroglycerin . . . .	..	547	Terebentum, 5 to 15 m. . .	..	734
Nitroglycerin, 1/100 and 1/250			Tercebtine . . . .	..	136
gr. . . .	..	558	Tereb. Canad. . . .	..	147
Novocain and Adrenalin . . .	..	323	„ Chia, 5 to 10 gr. . . .	..	828
Physostig. Salicyl., 1/500 gr.	..	641	Terpenes . . . .	..	112
Picrotoxin, 1/100 gr. . . .	..	—	Terpineol and Terpinenol . .	..	735
Pilocarpine HCl., ⅓ gr. . . .	..	522	Terpinol, 1 to 5 m. . . .	..	735
„ Nit., 1/10 to ½ gr. . . .	..	522	Terpine, Terpin. Hydrat., 2 to		
Quinine HBr., ½ gr. . . .	..	666	6 gr. . . .	..	735
„ HCl. Acid, 1, 2, and			Terra Alba . . . .	..	137
3 gr. . . .	..	670			

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Test Breakfast		460	Thermometric Equivs. Vol. I xxxvi.		
Testiculin, 15 to 30 m. ..		931	Thermos Flasks		615
Testis		931	Thialion, 1 dr.		529
Tetanus Antitoxin, 3000 to 8000 units intraspinally and 9000 to 16000 intravenously. (Proph., 500 to 1000 units subcut.), 877; Immunity Units, 879; Mag. Sulph. Injection, 531; Intracerebral, 879; Preparation, 879; Quinine in relation, 670, 880; Veterinary Use, 879; War Off. Memo, 878; Wound Dressing		878, 879	Thieleman's Drops, av. 30 m... ..		369
Tethelin		923	Thigenol, 490; Thio-carbamide, 753; Thiocol, 15 gr... ..		377
Tetrabromfluorescein		386	Thiodin		696
Tetrachlorethane .. 287, 440, 50			Thionin Solution	490,	556
Tetrachlorethylene		287	Thio-Resorcin		683
Tetra-ethyl diamino-triphenyl-carbinol		309	Thiosinamin, $\frac{1}{2}$ gr. inc. to 2 gr. (and Mull.)		694
Tetraiodo-eosin		386	,, Eth. Iodide (Inj.), 3 gr... ..		696
Tetramethyl-diarsine		180	Thio-Urea		753
Tetra-iodo-pyrrol, 1 to 3 gr. ..		495	Tholaform Tabs.		131
Tetranitro-methyl-aniline		300	Thoma-Zeiss App.		381
Tetra-oxy-diphosphamido-di-arseno-benzene		208	Thomson's Detoxicated Vaccines		909
Tetra-oxy-phthalophenon		635	,, Human Plasma-Glucose Agar		488
Tetra Vaccine		901	"Thoriac"		741
Tetryl		300	Thorii Aceto Coumaras, 31; Camph-Sulphonas, Cinnam., 741; Chloridum, 741; Glycerophosphas, 741; Hydroxidum. Nitras, 740; Orthocoum, 741; Lactas, 741; Oleas, 742; Oxidum, 740; Phthalas, 741; Quinas, Salicyl., 742; Sodio-Citras, 742; Sulphas. 741; Sulphocarb., etc. 742		
Teucrium		828	Thorium.. .. 740 et seq.		
Texas Fever		186	,, Pads		740
Thalleioquin		664	,, Solution for Kidney, etc., Exams.		742
Thalline Sulph., 3 to 5 gr		317	,, Radio active Disint. Products, see 337		
Thallium Acet		147	Threadworm		688
Thaolaxine		776	(and Therap. Index).		
Thapsia, 828; Theine, 1 to 5 gr. 243			Three Gland Tabs.		936
Theobrom Ol.; Pasta .. 735 & 147			Thrombin		70
Theobromine, 1 to 5 gr.. 243, 736 & 44, 147			Thromboplastin	913,	151
,, Aceto-Salicyl., 1 to 5 gr. 737			Thresh's Reagent		43
,, Aniso, 5 to 15 gr. .. 737			Throphleol, 403; Thuja		828
,, Sodium-Sal., 10 to 20 gr. 737			Thus Americanum		646
,, Sodio Acet., 10 to 15 gr. . 736			Thymaglycine, 10 to 30 m. ..		745
,, Sodio Form, 8 to 15 gr. . 737			Thymobenzene		467
,, Sodio Iod., 8 to 15 gr. . 737			Thymoform Tablets		746
,, -Iodo-Sal. 2 to 10 gr. .. 737			Thymol, $\frac{1}{2}$ to 2 gr.; Anthelmintic, 15 to 30 gr. ..		743
Theocin, 3 to 6 gr.		738	,, Antiseptic power		361
,, Sodium Acetate, 2 to 4 gr. 739			,, Carb., 5-15 gr. .. 421, 746		
Theophylline, 3 to 6 gr. .. 738			,, Disinfectant		745
,, Eth. Diamine (Injected), 6 gr		738	,, Iodide = Aristol, 494; Gauze		440
,, Sod. Acet., 2 to 4 gr. .. 739			,, Sol. (Volckmann's)		746
Theo-Sodo-Form., 8 to 15 gr... 737			,, Sulphonephthalein		459
Theo-Sodo-Sal., 10 to 20 gr... 737			,, Wool & Gauze		746
Theo-Sod-Acet., 10 to 15 gr. .. 736			Thymophthalein .. 172, 379, 459		
Thephorin, 8 to 15 gr.		737	Thymotal, 5 to 15 gr... ..		746
Therapeutic Coefficient		295	Thymus Gland (Liq. Ext., $\frac{1}{2}$ -2 dr.), 3-10 gr.		932
Therapeutic Index		959	Thymus Vulgaris		743, 828
Therapia Sterilisans Magna .. 190			Thyro-glandin, 3 to 5 gr. ..		935
Thermiol, 29, 404; Thermofuge, 430; Thermolaine, 437; Ther-moisolators		615			
Thermit		136			

FIGURES IN HEAVY TYPE, *e.g.* 100, REFER TO VOL. II.

NAME.	DOSE.	PAGE	NAME.	DOSE.	PAGE
Thyroid Gland ..	933, 154 <i>et seq</i>		<i>Tinct.</i> Cardam. & Co., $\frac{1}{2}$ to 1 dr.		786
„ „ Extract 935		„ Carminativa, 2–10 m. ..		768
„ Solution, 5–15 m. 934		„ Caryophylli, 2 to 10 m. ..		787
„ Assay (Iodine) ..	154, 155		„ Cascara Sag., 10 to 60 m. ..		271
„ Intravenous use ..	155		„ <i>Cascarilla</i> , $\frac{1}{2}$ to 1 dr. ..		787
„ Tablets Standardised, $1\frac{1}{2}$			„ Castorei, $\frac{1}{2}$ to 1 dr. ..		787
„ and 5 gr. 935		„ <i>Catechu</i> , $\frac{1}{2}$ to 1 dr. ..		788
„ References ..	936, 937, 151		„ <i>Chirata</i> , $\frac{1}{2}$ to 1 dr. ..		790
„ Variation ..	155 <i>et seq</i>		„ Chlorof. Co., 5–60 m. ..		287
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Thyroidectin, 5 gr. ..	938		15 m. ..		286
<i>Thyroideum Siccum</i> , $\frac{1}{2}$ –4 gr. 935;			„ Cimicifugæ, 30–60 m. ..		790
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Tick Fever ..	529		„ <i>Cocci</i> , 5 to 15 m. ..		786
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„ „ (Fleming), 1 to 5 m. ..	103		„ Coronillæ, 30–60 m. ..		792
„ „ „ <i>et Iodi</i> ..	103		„ Coto, 10 to 30 m. ..		369
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„ <i>Æsculi Hippoc.</i> , 10 m. ..	774		„ <i>Cubetæ</i> , $\frac{1}{2}$ to 1 dr. ..		378
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„ Aromatica = <i>Tinct. Cin-</i>			m. ..		796
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„ <i>Aurantii</i> , $\frac{1}{2}$ to 1 dr. ..	218		m. <i>in die</i> ..		797
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„ „ Churchill	502	„ <i>Scillæ</i> , 5 to 15 m.	..	821
„ „ et Aconiti	500	„ „ Phys. Stand, 5 to 15 m.	..	822
„ „ Æther., 505; Decol, and Decol. Fortis, 505; Oleosa	505	Senecionis, 1 to 2 dr.	..	822
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„ <i>Kaladanæ</i> , $\frac{1}{2}$ to 1 dr.	..	803	„ „ Phys. Standard	722 & 146	
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„ „ et Boracis	810	Tinctures, Aqueous, Glycerin..	..	747
„ <i>Nucis Vom.</i> , 5 to 15 m...	..	580	„ „ Ethereal, 747; <i>see</i> Tinct. Capsici Æther, etc.	..	
„ <i>Oliveri Cort.</i> , $\frac{1}{2}$ to 1 dr...	..	821	Tinea, 508 and Therap. Index.	..	
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„ „ Camph., ab. 1 dr.	..	607	Toad Extract 158 ; Flax	776
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„ <i>Podophylli (et Indic)</i> , 5 to 15 m.	..	655	„ Sulpho-dichloramide	62
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„ „ Intestinal		70
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Trimethyl-Benzoxypiperidine, 1/10 to $\frac{1}{2}$ gr.		329
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Triturations		748
„ Acidi Arseniosi, 1/6 to $\frac{2}{3}$ gr.		
„ Atropinæ Sulph., 1/20 to 1/10 gr.		
„ Cocainæ HCl., $\frac{1}{2}$ to 5 gr. ..		
„ Ferri Arsenatis, $\frac{5}{8}$ to 2 $\frac{1}{2}$ gr. .		
„ Morphinæ HCl., 1 to 3 gr. .		
„ PicROTOXINI, 1/10 to 2/5 gr. .		
„ Sodii Arsenatis, $\frac{1}{4}$ to 1 gr. .		
„ Strophanthi (1 grain = 10 minims Tinct. <i>Off.</i>), 1/5 to $\frac{1}{2}$ gr.		
„ Strychninæ, $\frac{1}{8}$ to $\frac{3}{8}$ gr. ..		
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„ Benzoici Co. T.H. (Ben- zoic Acid, Codeine, Co- caine, Ipecac., Menthol & Red Gum (marked C.B.A.) „ <i>Carbolici</i> , 1 gr., (S.) (marked C.A.)		19
„ <i>Tannici</i> , T., $\frac{1}{2}$ gr. and G., „ <i>Tannici</i> , F., 1 $\frac{1}{2}$ gr., T.H. „ <i>Tannici et Capsici</i> , F. Aconiti, F., Tinct. $\frac{1}{2}$ m. 1 every $\frac{1}{2}$ hour		103
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<i>Bismuthi Co.</i> , R., 2 gr. ..		
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Brompton Blacks		433
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Carbonis, S., 12 gr., 1 or 2 <i>p.c.</i>			Rosæ, S., <i>ad libitum.</i>		
Cascara gr., 2½ c. Menth. Pip.			Santonini, S., 1 gr., <i>h.s.</i>	..	688
F., 1 or 2 ..	271		Sedativi, F., 3 to 6 <i>p.d.</i>	..	600
Catechu. 1 gr., F., 2 gr. T.H.	788		Sodii Bicarb., R., 3 gr., <i>p.c.</i>		
Chlorodyne, 4 m., S., '85.			Sodii et Zingib., S., <i>p.c.</i>		
Cocain. HCl. S., 1/12 gr., T.H.			Chlorat., 3 gr., 3 to 6 <i>p.d.</i>	70	
F., 1/10 (marked H.C.), G.			Sulphuris, 5 gr., ½ <i>p.d.</i>	..	730
1/10			Terebene, 1 m., S.		
Codein, ½ gr., S., 4 or 5 <i>p.d.</i>	325		Tolutani S.		
Cubebæ, F., ½ gr., T.H.	378		Tussis, 4 or 5 <i>p.d.</i>	..	511
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Eucalypti Co., F., 1 gr.	796		Trommer's Test	..	401
„ Ol. 1 m. G.			Tropacocaine HCl.	..	328
Ferri Redacti, S., 1 gr., 1 or 2	408		Tropæolin	..	464
Formosyl (G.)	129		Tropic Acids Comps.	..	210
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„ et Opii, ¾ gr.			Trypaflavine	..	292
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„ Eucalypti, 1 gr., F.	796		Tse Tse Fly	..	531
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„ 1/20, and Cocaine, 1/20			Reaction	..	898
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„ ¼, and Eucalyp., 1 m., G.			„ Blister Reaction	..	898
Morphinæ, T., 1/32 gr., 4 or 5 <i>p.d.</i>			„ by Mouth	..	888
„ 1/32 gr., et Ipecac., 1/10 gr.			„ Crofton's	..	889
T., 4 or 5 <i>p.d.</i>	545		„ Cross Vaccination	..	888
„ 1/40 gr., & Emetin, 1/80			„ Cuti-reaction	..	897
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Papain, ½ gr., S., and 1/5 gr.			„ 'For and Against'	..	890
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Preface p. vii. For pyloborates read polyborates.

p. 298. Misprint in formula of Proflavine is corrected in this Vol. p. 249.

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„ 1110. Ung. Gallæ c. Opio should read 7.5%



